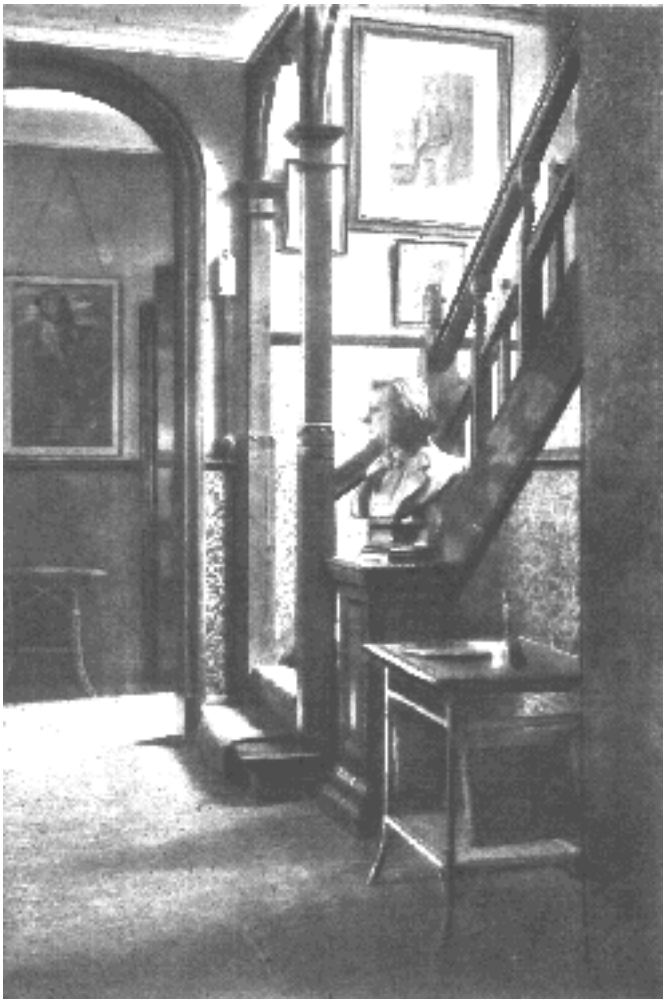

Bust of T.H H.
at Hodeslea House

Appleton ed., Vol. I frontispiece

Preface I

Method and Results

[v] The fourth of the "Collected Essays" in the volume now published gives an account of the indispensable conditions of scientific assent, as they are defined by the author of the famous "Discours de la Methode."

The other eight set forth the results which, in my judgment, are attained by the application of the "Method" of Descartes to the investigation of problems of widely various kinds; in the right solution of which we are all deeply interested, Hence I have given the volume the title of "Method and Results."

Written, for the most part, in the scant leisure of pressing occupations, or in the intervals of ill-health, these essays are free neither from superfluities in the way of repetition, nor from deficiencies which, I doubt not, will be even more conspicuous to other eyes than they are to my own. But so far as their substance goes, I find nothing to alter in them,–though the oldest bears the date of 1866. Whether that is evidence of the soundness of my opinions, or of my having made no progress in wisdom for the last quarter of a century, must be left to the courteous reader to decide.

Hodeslea, Eastbourne.
January 16th, 1893.

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THE HUXLEY FILE
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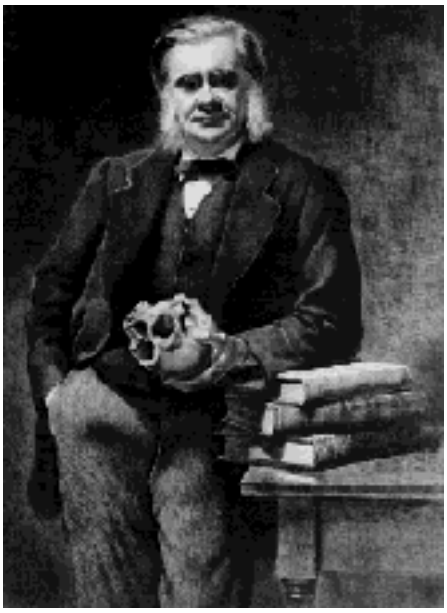

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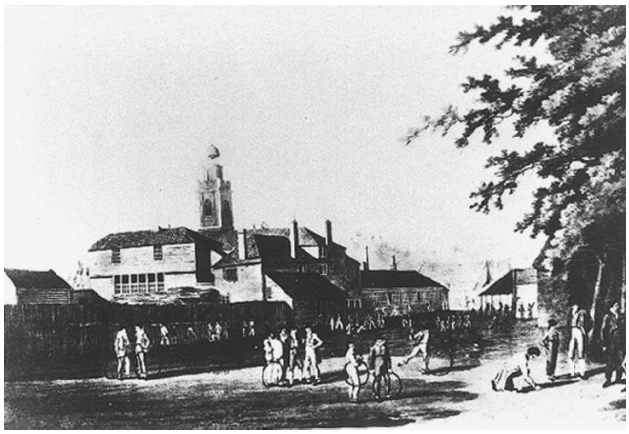
C. Blinderman & D. Joyce
Clark University

Ealing Church
Gentleman in front probably Dr. Nicholas



Ealing School and Playground

CB Collection

Autobiography (1890)

Collected Essays I

[1] And when I consider, in one view, the many things .....which I have upon my hands, I feel the burlesque of being employed in this manner at my time of life. But, in another view, and taking in all circumstances, these things, as trifling as they may appear, no less than things of greater importance, seem to be put upon me to do. ..... –*Bishop Butler to the Duchess of Somerset.*

The "many things" to which the Duchess's correspondent here refers are the repairs and improvements of the episcopal seat at Auckland. I doubt if the great apologist, greater in nothing than in the simple dignity of his character, would have considered the writing an account of himself as a thing which could be put upon him to do whatever circumstances might be taken in. But the good bishop lived in an age when a man might write books and yet be permitted to keep his private existence to himself; in the pre-Boswellian epoch, when the germ of the photographer lay in the womb of the distant future, and [2] the interviewer who pervades our age was an unforeseen, indeed unimaginable, birth of time.

At present, the most convinced believer in the aphorism "Bene qui latuit, bene vixit," is not always able to act up to it. An importunate person informs him that his portrait is about to be published and will be accompanied by a biography which the importunate person proposes to write. The sufferer knows what that means; either he undertakes to revise the "biography" or he does not. In the former case, he makes himself responsible; in the latter, he allows the publication of a mass of more or less fulsome inaccuracies for which he will be held responsible by those who are familiar with the prevalent art of self-advertisement. On the whole, it may be better to get over the "burlesque of being employed in this manner" and do the thing himself.

It was by reflections of this kind that, some years ago, I was led to write and permit the publication of the subjoined sketch.

I was born about eight o'clock in the morning on the 4th of May, 1825, at Ealing, which was, at that time, as quiet a little country village as could be found within half a dozen miles of Hyde Park Corner. Now it is a suburb of London with, I believe, 30,000 inhabitants. My father was one of the masters in a large semi-public school which at [3] one time had a high reputation. I am not aware that any portents preceded my arrival in this world; but, in my childhood, I remember hearing a traditional account of the manner in which I lost the chance of an endowment of great practical value. The windows of my mother's room were open, in consequence of the unusual warmth of the weather. For the same reason, probably, a neighbouring bee-hive had swarmed, and the new colony, pitching on the window-sill, was making its way into the room when the horrified nurse shut down the sash. If that well-meaning woman had only abstained from her ill-timed interference, the swarm might have settled on my lips, and I should have been endowed with that mellifluous eloquence which, in this country, leads far more surely than worth, capacity, or honest work, to the highest places in Church and State. But the opportunity was lost, and I have been obliged to content myself through life with saying what I mean in the plainest of plain language; than which, I suppose, there is no habit more ruinous to a man's prospects of advancement.

Why I was christened Thomas Henry I do not know; but it is a curious chance that my parents should have fixed for my usual denomination upon the name of that particular Apostle with whom I have always felt most sympathy. Physically and mentally I am the son of my mother so completely–even down to peculiar movements of the hands, [4] which made their appearance in me as I reached the age she had when I noticed them–that I can hardly find any trace of my father in myself, except an inborn faculty for drawing, which unfortunately, in my case, has never been cultivated; a hot temper; and that amount of tenacity of purpose, which unfriendly observers sometimes call obstinacy.

My mother was a slender brunette, of an emotional and energetic temperament, and possessed of the most piercing black eyes I ever saw in a woman's head. With no more education than other women of the middle classes in her day, she had an excellent mental capacity. Her most distinguishing characteristic, however, was rapidity of thought. If one ventured to suggest that she had not taken much time to arrive at any conclusion, she would say, 'I cannot help it, things flash across me.' That peculiarity has been passed on to me in full strength; it has often stood me in good stead; it has sometimes played me sad tricks, and it has always been a danger. But after all, if my time were to come over again, there is

nothing I would less willingly part with than my inheritance of mother wit.

I have next to nothing to say about my childhood. In later years, my mother, looking at me almost reproachfully, would sometimes say, 'Ah! you were such a pretty boy!' whence I had no difficulty in concluding that I had not [5] fulfilled my early promise in the matter of looks. In fact, I have a distinct recollection of certain curls, of which I was vain, and of a conviction that I closely resembled that handsome courtly gentleman, Sir Herbert Oakley, who was vicar of our parish, and who was as a god to us country folk, because he was occasionally visited by the then Prince George of Cambridge. I remember turning my pinafore wrong side forwards, in order to represent a surplice, and preaching to my mother's maids in the kitchen, as nearly as possible in Sir Herbert's manner, one Sunday morning when the rest of the family were at church. That is the earliest indication I can call to mind of the strong clerical affinities which my friend Mr. Herbert Spencer has always ascribed to me, though I fancy they have for the most part remained in a latent state.

My regular school training was of the briefest, perhaps fortunately, for though my way of life has made me acquainted with all sorts and conditions of men, from the highest to the lowest, I deliberately affirm that the society I fell into at school was the worst I have ever known. We boys were average lads, with much the same inherent capacity for good and evil as any others; but the people who were set over us cared about as much for our intellectual and moral welfare as if they were baby farmers. We were left to the operation of the struggle for existence among ourselves, and [6] bullying was the least of the ill practices current among us. Almost the only cheerful reminiscence in connection with the place, which arises in my mind, is that of a battle I had with one of my classmates, who had bullied me until I could stand it no longer. I was a very slight lad, but there was a wild-cat element in me which, when roused, made up for lack of weight, and I licked my adversary effectually. However, one of my first experiences of the extremely rough-and-ready nature of Justice, as exhibited by the course of things in general, arose out of the fact that I, the victor, had a black eye, while he, the vanquished, had none; so that I got into disgrace, and he did not. We made it up, and thereafter I was unmolested. One of the greatest shocks I ever received in my life was to be told, a dozen years afterwards, by the groom who brought me my horse, in a stable-yard in Sydney, that he was my quondam antagonist. He had a long story of family misfortune to account for his position; but at that time it was necessary to deal very cautiously with mysterious strangers in New South Wales, and on inquiry I found that the unfortunate young man had not only been 'sent out,' but had undergone more than one colonial conviction.

As I grew older, my great desire was to be a mechanical engineer, but the Fates were against this; and, while very young, I commenced the study of Medicine under a medical brother-in-law. But, [7] though the Institute of Mechanical Engineers would certainly not own me, I am not sure that I have not, all along, been a sort of mechanical engineer *in partibus infidelium.* I am now occasionally horrified to think how very little I ever knew or cared about Medicine as the art of healing. The only part of my professional course which really and deeply interested me was Physiology, which is the mechanical engineering of living machines; and, notwithstanding that natural science has been my proper business, I am afraid there is very little of the genuine naturalist in me. I never collected anything, and species work was always a burden to me; what I cared for was the architectural and engineering part of the business, the working out the wonderful unity of plan in the thousands and thousands of diverse living

constructions, and the modifications of similar apparatuses to serve diverse ends. The extraordinary attraction I felt towards the study of the intricacies of living structure nearly proved fatal to me at the outset. I was a mere boy–I think between thirteen and fourteen years of age–when I was taken by some older student friends of mine to the first post-mortem examination I ever attended. All my life I have been most unfortunately sensitive to the disagreeables which attend anatomical pursuits; but on this occasion, my curiosity overpowered all other feelings, and I spent two or three hours in gratifying it. I did [8] not cut myself, and none of the ordinary symptoms of dissection poison supervened, but poisoned I was somehow, and I remember sinking into a strange state of apathy. By way of a last chance I was sent to the care of some good, kind people, friends of my father's, who lived in a farmhouse in the heart of Warwickshire. I remember staggering from my bed to the window on the bright spring morning after my arrival, and throwing open the casement. Life seemed to come back on the wings of the breeze; and, to this day, the faint odour of wood-smoke, like that which floated across the farmyard in the early morning, is as good to me as the 'sweet south upon a bed of violets.' I soon recovered; but for years I suffered from occasional paroxysms of internal pain, and from that time my constant friend, hypochondriacal dyspepsia, commenced his half century of co-tenancy of my fleshly tabernacle.

Looking back on my 'Lehrjahre,' I am sorry to say that I do not think that any account of my doings as a student would tend to edification. In fact, I should distinctly warn ingenuous youth to avoid imitating my example. I worked extremely hard when it pleased me, and when it did not (which was a very frequent case) I was extremely idle (unless making caricatures of one's pastors and masters is to be called a branch of industry), or else wasted my energies in wrong directions. I read everything I could lay hands upon, in[9]cluding novels, and took up all sorts of pursuits, to drop them again quite as speedily. No doubt it was very largely my own fault, but the only instruction from which I ever obtained the proper effect of education was that which I received from Mr. Wharton Jones, who was the Lecturer on Physiology at the Charing Cross School of Medicine. The extent and precision of his knowledge impressed me greatly, and the severe exactness of his method of lecturing was quite to my taste. I do not know that I have ever felt so much respect for anybody before or since. I worked hard to obtain his approbation, and he was extremely kind and helpful to the youngster who, I am afraid, took up more of his time than he had any right to do. It was he who suggested the publication of my first scientific paper–a very little one–in the *Medical Gazette* of 1845, and most kindly corrected the literary faults which abounded in it, short as it was; for at that time, and for many years afterwards, I detested the trouble of writing, and would take no pains over lt.

It was in the early spring of 1846 that, having finished my obligatory medical studies, and passed the first M.B. examination at the London University (though I was still too young to qualify at the College of Surgeons), I was talking to a fellow-student–the present eminent physician, Sir Joseph Fayrer–and wondering what I should do to meet the imperative necessity for earning my own bread, [10] when my friend suggested that I should write to Sir William Burnett, at that time Director-General for the Medical Service of the Navy, for an appointment. I thought this rather a strong thing to do, as Sir William was personally unknown to me, but my cheery friend would not listen to my scruples, so I went to my lodgings and wrote the best letter I could devise. A few days afterwards I received the usual official circular of acknowledgment, but at the bottom there was written an instruction to call at Somerset House on such a day. I thought that looked like business, so, at the appointed time, I called and sent in my card,

while I waited in Sir William's ante-room. He was a tall, shrewd-looking old gentleman, with a broad Scotch accent–and I think I see him now as he entered with my card in his hand. The first thing he did was to return it, with the frugal reminder that I should probably find it useful on some other occasion. The second was to ask whether I was an Irishman. I suppose the air of modesty about my appeal must have struck him. I satisfied the Director-General that I was English to the backbone, and he made some inquiries as to my student career, finally desiring me to hold myself ready for examination. Having passed this, I was in Her Majesty's Service, and entered on the books of Nelson's old ship *Victory*, for duty at Haslar Hospital, about a couple of months after I made my application.

[11] My official chief at Haslar was a remarkable person–the late Sir John Richardson, an excellent naturalist, and far-famed as an indomitable Arctic traveller. He was a silent, reserved man outside the circle of his family and intimates; and, having a full share of youthful vanity, I was extremely disgusted to find that 'Old John,' as we irreverent youngsters called him, took not the slightest notice of my worshipful self, either the first time I attended him, as it was my duty to do, or for some weeks afterwards. I am afraid to think of the lengths to which my tongue might have run on the subject of the churlishness of the chief, who was in truth one of the kindest-hearted and most considerate of men. But one day, as I was crossing the Hospital square, Sir John stopped me, and heaped coals of fire on my head by telling me that he had tried to get me one of the resident appointments, much coveted by the assistant-surgeons, but that the Admiralty had put in another man. 'However,' said he, 'I mean to keep you here till I can get you something you will like,' and turned upon his heel without waiting for the thanks I stammered out. That explained how it was I had not been packed off to the West Coast of Africa, like some of my juniors, and why, eventually, I remained altogether seven months at Haslar.

After a long interval, during which 'Old John' ignored my existence almost as completely [12] as before, he stopped me again as we met in a casual way, and describing the service on which the *Rattlesnake* was likely to be employed, said that Captain Owen Stanley, who was to command the ship, had asked him to recommend an assistant-surgeon who knew something of science; would I like that? Of course I jumped at the offer. 'Very well, I give you leave; go to London at once and see Captain Stanley.' I went, saw my future commander, who was very civil to me and promised to ask that I should be appointed to his ship, as in due time I was. It is a singular thing that, during the few months of my stay at Haslar, I had among my messmates two future Directors-General of the Medical Service of the Navy (Sir Alexander Armstrong and Sir John Watt-Reid), with the present President of the College of Physicians and my kindest of doctors, Sir Andrew Clark. Life on board Her Majesty's ships in those days was a very different affair from what it is now; and ours was exceptionally rough, as we were often many months without receiving letters or seeing any civilised people but ourselves. In exchange, we had the interest of being about the last voyagers, I suppose, to whom it could be possible to meet with people who knew nothing of fire-arms–as we did on the South Coast of New Guinea–and of making acquaintance with a variety of interesting savage and semi-civilised [13] people. But, apart from experience of this kind, and the opportunities offered for scientific work, to me, personally, the cruise was extremely valuable. It was good for me to live under sharp discipline; to be down on the realities of existence by living on bare necessaries; to find out how extremely well worth living life seemed to be, when one woke up from a night's rest on a soft plank, with the sky for canopy and cocoa and weevilly biscuit the sole prospect for breakfast; and more especially to learn to work for the sake of what I got for myself out of it, even if it

all went to the bottom and I along with it. My brother officers were as good fellows as sailors ought to be and generally are; but, naturally, they neither knew nor cared anything about my pursuits, nor understood why I should be so zealous in pursuit of the objects which my friends the Middies christened 'Buffons,' after the title conspicuous on a volume of the 'Suites à Buffon,' which stood on my shelf in the chart room.

During the four years of our absence, I sent home communication after communication to the 'Linnean Society,' with the same result as that obtained by Noah when he sent the raven out of his ark. Tired at last of hearing nothing about them, I determined to do or die, and, in 1849, I drew up a more elaborate paper and forwarded it to the Royal Society. This was my dove, if I had only known it. But owing to the movements of [14] the ship, I heard nothing of that either, until my return to England in the latter end of the year I850, when I found that it was printed and published, and that a huge packet of separate copies awaited me. When I hear some of my young friends complain of want of sympathy and encouragement, I am inclined to think that my naval life was not the least valuable part of my education.

Three years after my return were occupied by a battle between my scientific friends on the one hand, and the Admiralty on the other, as to whether the latter ought, or ought not, to act up to the spirit of a pledge they had given to encourage officers who had done scientific work, by contributing to the expense of publishing mine. At last, the Admiralty, getting tired, I suppose, cut short the discussion by ordering me to join a ship. Which thing I declined to do, and as Rastignac, in the Père Goriot, says to Paris, I said to London, '*à nous deux.*' I desired to obtain a Professorship of either Physiology or Comparative Anatomy; and as vacancies occurred, I applied, but in vain. My friend Professor Tyndall, and I were candidates at the same time, he for the Chair of Physics and I for that of Natural History, in the University of Toronto, which fortunately, as it turned out, would not look at either of us. I say fortunately, not from any lack of respect for Toronto, but because I soon made up my mind that London was the place for me, and hence I have steadily declined [15] the inducements to leave it which have at various times been offered. At last, in 1854, on the translation of my warm friend, Edward Forbes, to Edinburgh, Sir Henry De la Beche, the Director General of the Geological Survey, offered me the post Forbes vacated of Paleontologist and Lecturer on Natural History. I refused the former point blank, and accepted the latter provisionally, telling Sir Henry that I did not care for fossils, and that I should give up Natural History as soon as I could get a physiological post. But I held the office for thirty-one years, and a large part of my work has been paleontological.

At that time I disliked public speaking, and had a firm conviction that I should break down every time I opened my mouth. I believe I had every fault a speaker could have (except talking at random or indulging in rhetoric) when I spoke to the first important audience I ever addressed, on a Friday evening, at the Royal Institution, in 1852. Yet I must confess to having been guilty, *malgré moi*, of as much public speaking as most of my contemporaries, and for the last ten years it ceased to be so much of a bugbear to me. I used to pity myself for having to go through this training; but I am now more disposed to compassionate the unfortunate audiences, especially my ever friendly hearers at the Royal Institution, who were the subjects of my oratorical experiments.

The last thing that it would be proper for me [16] to do would be to speak of the work of my life, or to

say at the end of the day, whether I think I have earned my wages or not. Men are said to be partial judges of themselves–young men may be, I doubt if old men are. Life seems terribly foreshortened as they look back; and the mountain they set themselves to climb in youth turns out to be a mere spur of immeasurably higher ranges, when, with failing breath, they reach the top. But if I may speak of the objects I have had more or less definitely in view since I began the ascent of my hillock, they are briefly these: to promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction–which has grown with my growth and strengthened with my strength–that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is, when the garment of make-believe, by which pious hands have hidden its uglier features, is stripped off.

It is with this intent that I have subordinated any reasonable or unreasonable ambition for scientific fame, which I may have permitted myself to entertain, to other ends; to the popularisation of science; to the development and organisation of scientific education; to the endless series of battles and skirmishes over evolution; and to untiring opposition to that ecclesiastical spirit, that [17] clericalism, which in England, as everywhere else, and to whatever denomination it may belong, is the deadly enemy of science.

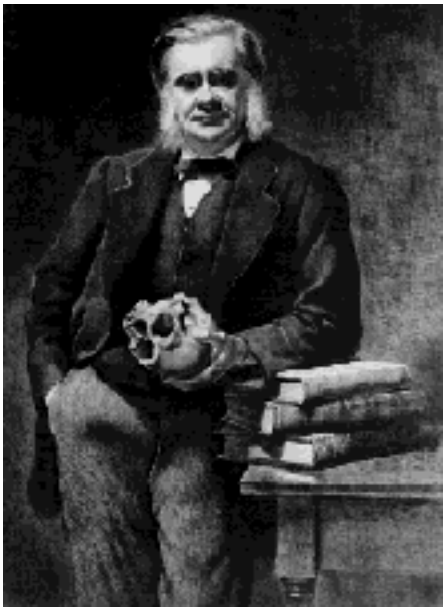
In striving for the attainment of these objects, I have been but one among many, and I shall be well content to be remembered, or even not remembered, as such. Circumstances, among which I am proud to reckon the devoted kindness of many friends, have led to my occupation of various prominent positions, among which the Presidency of the Royal Society is the highest. It would be mock modesty on my part, with these and other scientific honours which have been bestowed upon me, to pretend that I have not succeeded in the career which I have followed, rather because I was driven into it, than of my own free will; but I am afraid I should not count even these things as marks of success, if I could not hope that I had somewhat helped that movement of opinion which has been called the New Reformation.

T. H. H. Tombstone
Marylebore Cemetary

Gothic Apex

CB Collection

THE HUXLEY FILE



Preface and Table of Contents to Volume I, *Results and Methods,* of Huxley's *Collected Essays.*

Next article: On the Advisableness of Improving Natural Knowledge [1866], pages 18-41.

C. Blinderman & D. Joyce
Clark University

On the Advisableness of Improving Natural Knowledge (1866)

Collected Essays I

[18] This time two hundred years ago–in the beginning of January, 1666–those of our forefathers who inhabited this great and ancient city, took breath between the shocks of two fearful calamities: one not quite past, although its fury had abated; the other to come.

Within a few yards of the very spot on which we are assembled, so the tradition runs, that painful and deadly malady, the plague, appeared in the latter months of 1664; and, though no new visitor, smote the people of England, and especially of her capital, with a violence unknown before, in the course of the following year. The hand of a master has pictured what happened in those dismal months; and in that truest of fictions, "The History of the Plague Year," Defoe shows [19] death, with every accompaniment of pain and terror, stalking through the narrow streets of old London, and changing their busy hum into a silence broken only by the wailing of the mourners of fifty thousand dead; by the woful denunciations and mad prayers of fanatics; and by the madder yells of despairing profligates.

But, about this time in 1666, the death-rate had sunk to nearly its ordinary amount; a case of plague occurred only here and there, and the richer citizens who had flown from the pest had returned to their dwellings. The remnant of the people began to toil at the accustomed round of duty, or of pleasure; and the stream of city life bid fair to flow back along its old bed, with renewed and uninterrupted vigour.

The newly-kindled hope was deceitful. The great plague, indeed, returned no more; but what it had done for the Londoners, the great fire, which broke out in the autumn of 1666, did for London; and, in September of that year, a heap of ashes and the indestructible energy of the people were all that remained of the glory of five-sixths of the city within the walls.

Our forefathers had their own ways of accounting for each of these calamities. They submitted to the plague in humility and in penitence, for they believed it to be the judgment of God. But, towards the fire they were furiously indignant, [20] interpreting it as the effect of the malice of man,–as the work of the Republicans, or of the Papists, according as their prepossessions ran in favour of loyalty or of Puritanism.

It would, I fancy, have fared but ill with one who, standing where I now stand, in what was then a thickly-peopled and fashionable part of London, should have broached to our ancestors the doctrine which I now propound to you–that all their hypotheses were alike wrong; that the plague was no more, in their sense, Divine judgment, than the fire was the work of any political, or of any religious, sect; but that they were themselves the authors of both plague and fire, and that they must look to themselves to prevent the recurrence of calamities, to all appearance so peculiarly beyond the reach of human control–so evidently the result of the wrath of God, or of the craft and subtlety of an enemy.

And one may picture to one's self how harmoniously the holy cursing of the Puritan of that day would

have chimed in with the unholy cursing and the crackling wit of the Rochesters and Sedleys, and with the revilings of the political fanatics, if my imaginary plain dealer had gone on to say that, if the return of such misfortunes were ever rendered impossible, it would not be in virtue of the victory of the faith of Laud, or of that of Milton; and, as little, by the triumph of republicanism, as by that of monarchy. But that [21] the one thing needful for compassing this end was that the people of England should second the efforts of an insignificant corporation, the establishment of which, a few years before the epoch of the great plague and the great fire, had been as little noticed, as they were conspicuous.

Some twenty years before the outbreak of the plague a few calm and thoughtful students banded themselves together for the purpose, as they phrased it, of "improving natural knowledge." The ends they proposed to attain cannot be stated more clearly than in the words of one of the founders of the organisation:–

"Our business was (precluding matters of theology and state affairs) to discourse and consider of philosophical enquiries, and such as related thereunto:–as Physick, Anatomy, Geometry, Astronomy, Navigation, Staticks, Magneticks, Chymicks, Mechanicks and Natural Experiments; with the state of these studies and their cultivation at home and abroad. We then discoursed of the circulation of the blood, the valves in the veins, the venae lacteæ, the lymphatic vessels, the Copernican hypothesis, the nature of comets and new stars, the satellites of Jupiter, the oval shape (as it then appeared) of Saturn, the spots on the sun and its turning on its own axis, the inequalities and selenography of the moon, the several phases of Venus and Mercury, the im[22]provement of telescopes and grinding of glasses for that purpose, the weight of air, the possibility or impossibility of vacuities and nature's abhorrence thereof, the Torricellian experiment in quicksilver, the descent of heavy bodies and the degree of acceleration therein, with divers other things of like nature, some of which were then but new discoveries, and others not so generally known and embraced as now they are; with other things appertaining to what hath been called the New Philosophy, which from the times of Galileo at Florence, and Sir Francis Bacon (Lord Verulam) in England, hath been much cultivated in Italy, France, Germany, and other parts abroad, as well as with us in England."

The learned Dr. Wallis, writing in 1696, narrates in these words, what happened half a century before, or about 1645. The associates met at Oxford, in the rooms of Dr. Wilkins, who was destined to become a bishop; and subsequently coming together in London, they attracted the notice of the king. And it is a strange evidence of the taste for knowledge which the most obviously worthless of the Stuarts shared with his father and grandfather, that Charles the Second was not content with saying witty things about his philosophers, but did wise things with regard to them. For he not only bestowed upon them such attention as he could spare from his poodles and his mistresses, but, [23] being in his usual state of impecuniosity, begged for them of the Duke of Ormond; and, that step being without effect, gave them Chelsea College, a charter, and a mace: crowning his favours in the best way they could be crowned, by burdening them no further with royal patronage or state interference

Thus it was that the half-dozen young men, studious of the "New Philosophy," who met in one another's lodgings in Oxford or in London, in the middle of the seventeenth century, grew in numerical and in real strength, until, in its latter part, the "Royal Society for the Improvement of Natural Knowledge" had

already become famous, and had acquired a claim upon the veneration of Englishmen, which it has ever since retained, as the principal focus of scientific activity in our islands, and the chief champion of the cause it was formed to support.

It was by the aid of the Royal Society that Newton published his "Principia." If all the books in the world, except the "Philosophical Transactions," were destroyed, it is safe to say that the foundations of physical science would remain unshaken, and that the vast intellectual progress of the last two centuries would be largely, though incompletely, recorded. Nor have any signs of halting or of decrepitude manifested themselves in our own times. As in Dr. Wallis's days, so in these, "our business is, precluding theology and [24] state affairs, to discourse and consider of philosophical enquiries." But our "Mathematick" is one which Newton would have to go to school to learn; our "Staticks, Mechanicks, Magneticks, Chymicks, and Natural Experiments" constitute a mass of physical and chemical knowledge, a glimpse at which would compensate Galileo for the doings of a score of inquisitorial cardinals; our "Physick" and "Anatomy" have embraced such infinite varieties of being, have laid open such new worlds in time and space, have grappled, not unsuccessfully, with such complex problems, that the eyes of Vesalius and of Harvey might be dazzled by the sight of the tree that has grown out of their grain of mustard seed.

The fact is perhaps rather too much, than too little, forced upon one's notice, nowadays, that all this marvellous intellectual growth has a no less wonderful expression in practical life; and that, in this respect, if in no other, the movement symbolised by the progress of the Royal Society stands without a parallel in the history of mankind.

A series of volumes as bulky as the "Transactions of the Royal Society" might possibly be filled with the subtle speculations of the Schoolmen; not improbably, the obtaining a mastery over the products of mediæval thought might necessitate an even greater expenditure of time and of energy than the acquirement of the "New Philosophy;" [25] but though such work engrossed the best intellects of Europe for a longer time than has elapsed since the great fire, its effects were "writ in water," so far as our social state is concerned.

On the other hand, if the noble first President of the Royal Society could revisit the upper air and once more gladden his eyes with a sight of the familiar mace, he would find himself in the midst of a material civilisation more different from that of his day, than that of the seventeenth was from that of the first century. And if Lord Brouncker's native sagacity had not deserted his ghost, he would need no long reflection to discover that all these great ships, these railways, these telegraphs, these factories, these printing-presses, without which fabric of modern English society would collapse into a mass of stagnant and starving pauperism,–that all these pillars of our State are but the ripples and the bubbles upon the surface of that great spiritual stream, the springs of which only, he and his fellows were privileged to see; and seeing, to recognise as that which it behoved them above all things to keep pure and undefiled.

It may not be too great a flight of imagination to conceive our noble *revenant* not forgetful of the great troubles of his own day, and anxious to know how often London had been burned down since his time,

and how often the plague had carried off its thousands. He would have to learn that, [26] although London contains tenfold the inflammable matter that it did in 1666; though, not content with filling our rooms with woodwork and light draperies, we must needs lead inflammable and explosive gases into every corner of our streets and houses, we never allow even a street to burn down. And if he asked how this had come about, we should have to explain that the improvement of natural knowledge has furnished us with dozens of machines for throwing water upon fires, any one of which would have furnished the ingenious Mr. Hooke, the first "curator and experimenter" of the Royal Society, with ample materials for discourse before half a dozen meetings of that body; and that, to say truth, except for the progress of natural knowledge, we should not have been able to make even the tools by which these machines are constructed. And, further, it would be necessary to add, that although severe fires sometimes occur and inflict great damage, the loss is very generally compensated by societies, the operations of which have been rendered possible only by the progress of natural knowledge in the direction of mathematics, and the accumulation of wealth in virtue of other natural knowledge.

But the plague? My Lord Brouncker's observation would not, I fear, lead him to think that Englishmen of the nineteenth century are purer in life, or more fervent in religious faith, than the [27] generation which could produce a Boyle, an Evelyn, and a Milton. He might find the mud of society at the bottom, instead of at the top, but I fear that the sum total would be as deserving of swift judgment as at the time of the Restoration. And it would be our duty to explain once more, and this time not without shame, that we have no reason to believe that it is the improvement of our faith, nor that of our morals, which keeps the plague from our city; but, again, that it is the improvement of our natural knowledge.

We have learned that pestilences will only take up their abode among those who have prepared unswept and ungarnished residences for them. Their cities must have narrow, unwatered streets, foul with accumulated garbage. Their houses must be ill-drained, ill-lighted, ill-ventilated. Their subjects must be ill-washed, ill-fed, ill-clothed. The London of 1665 was such a city. The cities of the East, where plague has an enduring dwelling, are such cities. We, in later times, have learned somewhat of Nature, and partly obey her. Because of this partial improvement of our natural knowledge and of that fractional obedience, we have no plague; because that knowledge is still very imperfect and that obedience yet incomplete, typhoid is our companion and cholera our visitor. But it is not presumptuous to express the belief that, when our knowledge is [28] more complete and our obedience the expression of our knowledge, London will count her centuries of freedom from typhoid and cholera, as she now gratefully reckons her two hundred years of ignorance of that plague which swooped upon her thrice in the first half of the seventeenth century.

Surely, there is nothing in these explanations which is not fully borne out by the facts? Surely, the principles involved in them are now admitted among the fixed beliefs of all thinking men? Surely, it is true that our countrymen are less subject to fire, famine, pestilence, and all the evils which result from a want of command over and due anticipation of the course of Nature, than were the countrymen of Milton; and health, wealth, and well-being are more abundant with us than with them? But no less certainly is the difference due to the improvement of our knowledge of Nature, and the extent to which that improved knowledge has been incorporated with the household words of men, and has supplied the springs of their daily actions.

Granting for a moment, then, the truth of that which the depreciators of natural knowledge are so fond of urging, that its improvement can only add to the resources of our material civilisation; admitting it to be possible that the founders of the Royal Society themselves looked for no other reward than this, I cannot confess that I was [29] guilty of exaggeration when I hinted, that to him who had the gift of distinguishing between prominent events and important events, the origin of a combined effort on the part of mankind to improve natural knowledge might have loomed larger than the Plague and have outshone the glare of the Fire; as a something fraught with a wealth of beneficence to mankind, in comparison with which the damage done by those ghastly evils would shrink into insignificance.

It is very certain that for every victim slain by the plague, hundreds of mankind exist and find a fair share of happiness in the world by the aid of the spinning jenny. And the great fire, at its worst, could not have burnt the supply of coal, the daily working of which, in the bowels of the earth, made possible by the steam pump, gives rise to an amount of wealth to which the millions lost in old London are but as an old song.

But spinning jenny and steam pump are, after all, but toys, possessing an accidental value; and natural knowledge creates multitudes of more subtle contrivances, the praises of which do not happen to be sung because they are not directly convertible into instruments for creating wealth. When I contemplate natural knowledge squandering such gifts among men, the only appropriate comparison I can find for her is, to liken her to such [30] a peasant woman as one sees in the Alps, striding ever upward, heavily burdened, and with mind bent only on her home; but yet without effort and without thought, knitting for her children. Now stockings are good and comfortable things, and the children will undoubtedly be much the better for them; but surely it would be shortsighted, to say the least of it, to depreciate this toiling mother as a mere stocking-machine–a mere provider of physical comforts?

However, there are blind leaders of the blind, and not a few of them, who take this view of natural knowledge, and can see nothing in the bountiful mother of humanity but a sort of comfort-grinding machine. According to them, the improvement of natural knowledge always has been, and always must be, synonymous with no more than the improvement of the material resources and the increase of the gratifications of men.

Natural knowledge is, in their eyes, no real mother of mankind, bringing them up with kindness, and, if need be, with sternness, in the way they should go, and instructing them in all things needful for their welfare; but a sort of fairy godmother, ready to furnish her pets with shoes of swiftness, swords of sharpness, and omnipotent Aladdin's lamps, so that they may have telegraphs to Saturn, and see the other side of the moon, and thank God they are better than their benighted ancestors.

[31] If this talk were true, I, for one, should not greatly care to toil in the service of natural knowledge. I think I would just as soon be quietly chipping my own flint axe, after the manner of my forefathers a few thousand years back, as be troubled with the endless malady of thought which now infests us all, for such reward. But I venture to say that such views are contrary alike to reason and to fact. Those who

discourse in such fashion seem to me to be so intent upon trying to see what is above Nature, or what is behind her, that they are blind to what stares them in the face in her.

I should not venture to speak thus strongly if my justification were not to be found in the simplest and most obvious facts,–if it needed more than an appeal to the most notorious truths to justify my assertion, that the improvement of natural knowledge, whatever direction it has taken, and however low the aims of those who may have commenced it–has not only conferred practical benefits on men, but, in so doing, has effected a revolution in their conceptions of the universe and of themselves, and has profoundly altered their modes of thinking and their views of right and wrong. I say that natural knowledge, seeking to satisfy natural wants, has found the ideas which can alone still spiritual cravings. I say that natural knowledge, in desiring to ascertain the laws of comfort, has been driven to discover those [32] of conduct, and to lay the foundations of a new morality.

Let us take these points separately; and first, what great ideas has natural knowledge introduced into men's minds?

I cannot but think that the foundations of all natural knowledge were laid when the reason of man first came face to face with the facts of Nature; when the savage first learned that the fingers of one hand are fewer than those of both; that it is shorter to cross a stream than to head it; that a stone stops where it is unless it be moved, and that it drops from the hand which lets it go; that light and heat come and go with the sun; that sticks burn away in a fire; that plants and animals grow and die; that if he struck his fellow savage a blow he would make him angry, and perhaps get a blow in return, while if he offered him a fruit he would please him, and perhaps receive a fish in exchange. When men had acquired this much knowledge, the outlines, rude though they were, of mathematics, of physics, of chemistry, of biology, of moral, economical, and political science, were sketched. Nor did the germ of religion fail when science began to bud. Listen to words which, though new, are yet three thousand years old:–

". . . When in heaven the stars about the moon
Look beautiful, when all the winds are laid,
[33] And every height comes out, and jutting peak
And valley, and the immeasurable heavens
Break open to their highest, and all the stars
Shine, and the shepherd gladdens in his heart."[1]

If the half savage Greek could share our feelings thus far, it is irrational to doubt that he went further, to find as we do, that upon that brief gladness there follows a certain sorrow,–the little light of awakened human intelligence shines so mere a spark amidst the abyss of the unknown and unknowable; seems so insufficient to do more than illuminate the imperfections that cannot be remedied, the aspirations that cannot be realised, of man's own nature. But in this sadness, this consciousness of the limitation of man, this sense of an open secret which he cannot penetrate, lies the essence of all religion; and the attempt to embody it in the forms furnished by the intellect is the origin of the higher theologies.

Thus it seems impossible to imagine but that the foundations of all knowledge secular or sacred–were

laid when intelligence dawned, though the superstructure remained for long ages so slight and feeble as to be compatible with the existence of almost any general view respecting the mode of governance of the universe. No doubt, from the first, there were certain phænomena which, to the rudest mind, presented a [34] constancy of occurrence, and suggested that a fixed order ruled, at any rate, among them. I doubt if the grossest of Fetish worshippers ever imagined that a stone must have a god within it to make it fall, or that a fruit had a god within it to make it taste sweet. With regard to such matters as these, it is hardly questionable that mankind from the first took strictly positive and scientific views.

But, with respect to all the less familiar occurrences which present themselves, uncultured man, no doubt, has always taken himself as the standard of comparison, as the centre and measure of the world; nor could he well avoid doing so. And finding that his apparently uncaused will has a powerful effect in giving rise to many occurrences, he naturally enough ascribed other and greater events to other and greater volitions, and came to look upon the world and all that therein is, as the product of the volitions of persons like himself, but stronger, and capable of being appeased or angered, as he himself might be soothed or irritated. Through such conceptions of the plan and working of the universe all mankind have passed, or are passing. And we may now consider what has been the effect of the improvement of natural knowledge on the views of men who have reached this stage, and who have begun to cultivate natural knowledge with no desire but that of "increasing God's honour and bettering man's estate."

[35] For example, what could seem wiser, from a mere material point of view, more innocent, from a theological one, to an ancient people, than that they should learn the exact succession of the seasons, as warnings for their husbandmen; or the position of the stars, as guides to their rude navigators? But what has grown out of this search for natural knowledge of so merely useful a character? You all know the reply. Astronomy,–which of all sciences has filled men's minds with general ideas of a character most foreign to their daily experience, and has, more than any other, rendered it impossible for them to accept the beliefs of their fathers. Astronomy,–which tells them that this so vast and seemingly solid earth is but an atom among atoms, whirling, no man knows whither, through illimitable space; which demonstrates that what we call the peaceful heaven above us, is but that space, filled by an infinitely subtle matter whose particles are seething and surging, like the waves of an angry sea; which opens up to us infinite regions where nothing is known, or ever seems to have been known, but matter and force, operating according to rigid rules; which leads us to contemplate phænomena the very nature of which demonstrates that they must have had a beginning, and that they must have an end, but the very nature of which also proves that the beginning was, to our conceptions of time, [36] infinitely remote, and that the end is as immeasurably distant.

But it is not alone those who pursue astronomy who ask for bread and receive ideas. What more harmless than the attempt to lift and distribute water by pumping it; what more absolutely and grossly utilitarian? Yet out of pumps grew the discussions about Nature's abhorrence of a vacuum and then it was discovered that Nature does not abhor a vacuum, but that air has weight; and that notion paved the way for the doctrine that all matter has weight, and that the force which produces weight is co-extensive with the universe,–in short, to the theory of universal gravitation and endless force. While learning how to handle gases led to the discovery of oxygen, and to modern chemistry, and to the notion of the indestructibility of matter.

Again, what simpler, or more absolutely practical, than the attempt to keep the axle of a wheel from heating when the wheel turns round very fast? How useful for carters and gig drivers to know something about this; and how good were it, if any ingenious person would find out the cause of such phænomena, and thence educe a general remedy for them. Such an ingenious person was Count Rumford; and he and his successors have landed us in the theory of the persistence, or indestructibility, of force. And in the infinitely minute, as in the infinitely great, [37] the seekers after natural knowledge of the kinds called physical and chemical, have everywhere found a definite order and succession of events which seem never to be infringed.

And how has it fared with "Physick" and Anatomy? Have the anatomist, the physiologist, or the physician, whose business it has been to devote themselves assiduously to that eminently practical and direct end, the alleviation of the sufferings of mankind,–have they been able to confine their vision more absolutely to the strictly useful? I fear they are the worst offenders of all. For if the astronomer has set before us the infinite magnitude of space, and the practical eternity of the duration of the universe; if the physical and chemical philosophers have demonstrated the infinite minuteness of its constituent parts, and the practical eternity of matter and of force; and if both have alike proclaimed the universality of a definite and predicable order and succession of events, the workers in biology have not only accepted all these, but have added more startling theses of their own. For, as the astronomers discover in the earth no centre of the universe, but an eccentric speck, so the naturalists find man to be no centre of the living world, but one amidst endless modifications of life; and as the astronomer observes the mark of practically endless time set upon the arrangements of the solar system so the student of life finds the records [38] of ancient forms of existence peopling the world for ages, which, in relation to human experience, are infinite.

Furthermore, the physiologist finds life to be as dependent for its manifestation on particular molecular arrangements as any physical or chemical phænomenon; and wherever he extends his researches, fixed order and unchanging causation reveal themselves, as plainly as in the rest of Nature.

Nor can I find that any other fate has awaited the germ of Religion. Arising, like all other kinds of knowledge, out of the action and interaction of man's mind, with that which is not man's mind, it has taken the intellectual coverings of Fetishism or Polytheism; of Theism or Atheism; of Superstition or Rationalism. With these, and their relative merits and demerits, I have nothing to do; but this it is needful for my purpose to say, that if the religion of the present differs from that of the past, it is because the theology of the present has become more scientific than that of the past; because it has not only renounced idols of wood and idols of stone, but begins to see the necessity of breaking in pieces the idols built up of books and traditions and fine-spun ecclesiastical cobwebs: and of cherishing the noblest and most human of man's emotions, by worship "for the most part of the silent sort" at the altar of the Unknown.

Such are a few of the new conceptions implanted [39] in our minds by the improvement of natural knowledge. Men have acquired the ideas of the practically infinite extent of the universe and of its

practical eternity; they are familiar with the conception that our earth is but an infinitesimal fragment of that part of the universe which can be seen; and that, nevertheless, its duration is, as compared with our standards of time, infinite. They have further acquired the idea that man is but one of innumerable forms of life now existing on the globe, and that the present existences are but the last of an immeasurable series of predecessors. Moreover, every step they have made in natural knowledge has tended to extend and rivet in their minds the conception of a definite order of the universe which is embodied in what are called, by an unhappy metaphor, the laws of Nature and to narrow the range and loosen the force of men's belief in spontaneity, or in changes other than such as arise out of that definite order itself.

Whether these ideas are well or ill founded is not the question. No one can deny that they exist, and have been the inevitable outgrowth of the improvement of natural knowledge. And if so, it cannot be doubted that they are changing the form of men's most cherished and most important convictions.

And as regards the second point–the extent to which the improvement of natural knowledge has [40] remodelled and altered what may be termed the intellectual ethics of men,–what are among the moral convictions most fondly held by barbarous and semi-barbarous people.

They are the convictions that authority is the soundest basis of belief; that merit attaches to a readiness to believe; that the doubting disposition is a bad one, and scepticism a sin; that when good authority has pronounced what is to be believed, and faith has accepted it, reason has no further duty. There are many excellent persons who yet hold by these principles, and it is not my present business, or intention, to discuss their views. All I wish to bring clearly before your minds is the unquestionable fact, that the improvement of natural knowledge is effected by methods which directly give the lie to all these convictions, and assume the exact reverse of each to be true.

The improver of natural knowledge absolutely refuses to acknowledge authority, as such. For him, scepticism is the highest of duties; blind faith the one unpardonable sin. And it cannot be otherwise, for every great advance in natural knowledge has involved the absolute rejection of authority, the cherishing of the keenest scepticism, the annihilation of the spirit of blind faith; and the most ardent votary of science holds his firmest convictions, not because the men he most venerates hold them, not because their verity is testified by portents and wonders; but because his experi[41]ence teaches him that whenever he chooses to bring these convictions into contact with their primary source, Nature–whenever he thinks fit to test them by appealing to experiment and to observation–Nature will confirm them. The man of science has learned to believe in justification, not by faith, but by verification.

Thus, without for a moment pretending to despise the practical results of the improvement of natural knowledge, and its beneficial influence on material civilisation, it must, I think, be admitted that the great ideas, some of which I have indicated, and the ethical spirit which I have endeavoured to sketch, in the few moments which remained at my disposal, constitute the real and permanent significance of natural knowledge.

If these ideas be destined, as I believe they are, to be more and more firmly established as the world

grows older; if that spirit be fated, as I believe it is, to extend itself into all departments of human thought, and to become co-extensive with the range of knowledge; if, as our race approaches its maturity, it discovers, as I believe it will, that there is but one kind of knowledge and but one method of acquiring it; then we, who are still children, may justly feel it our highest duty to recognise the advisableness of improving natural knowledge, and so to aid ourselves and our successors in our course towards the noble goal which lies before mankind.

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[1] Need it be said that this is Tennyson's English for Homer's Greek?

THE HUXLEY FILE

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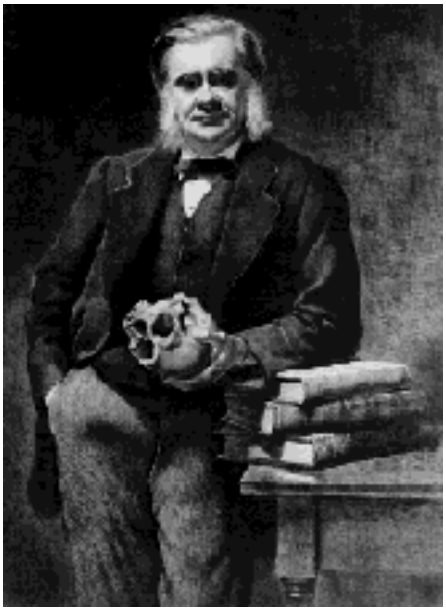

The Progress of Science (1887)

Collected Essays I

[42] The most obvious and the most distinctive feature of the History of Civilisation, during the last fifty years, is the wonderful increase of industrial production by the application of machinery, the improvement of old technical processes and the invention of new ones, accompanied by an even more remarkable development of old and new means of locomotion and intercommunication. By this rapid and vast multiplication of the commodities and conveniences of existence, the general standard of comfort has been raised; the ravages of pestilence and famine have been checked; and the natural obstacles, which time and space offer to mutual intercourse, have been reduced in a manner, and to an extent, unknown to former ages. The diminution or removal of local ignorance and prejudice, the creation of common [43] interests among the most widely separated peoples, and the strengthening of the forces of the organisation of the commonwealth against those of political or social anarchy, thus effected, have exerted an influence on the present and future fortunes of mankind the full significance of which may be divined, but cannot, as yet, be estimated at its full value.

This revolution–for it is nothing less–in the political and social aspects of modern civilisation has been preceded, accompanied, and in great measure caused, by a less obvious, but no less marvellous, increase of natural knowledge, and especially of that part of it which is known as Physical Science, in consequence of the application of scientific method to the investigation of the phenomena of the material world. Not that the growth of physical science is an exclusive prerogative of the Victorian age. Its present strength and volume merely indicate the highest level of a stream which took its rise alongside of the primal founts of Philosophy, Literature, and Art, in ancient Greece; and, after being dammed up for a thousand years, once more began to flow three centuries ago.

It may be doubted if even-handed justice, as free from fulsome panegyric as from captious depreciation, has ever yet been dealt out to the sages of antiquity who, for eight centuries, from the time of Thales to that of Galen, toiled at the [44] foundations of physical science. But, without entering into the discussion of that large question, it is certain that the labours of these early workers in the field of natural knowledge were brought to a standstill by the decay and disruption of the Roman Empire, the consequent disorganisation of society, and the diversion of men's thoughts from sublunary matters to the problems of the supernatural world suggested by Christian dogma in the Middle Ages. And, notwithstanding sporadic attempts to recall men to the investigation of nature, here and there, it was not until the fifteenth and sixteenth centuries that physical science made a new start, founding itself, at first, altogether upon that which had been done by the Greeks. Indeed, it must be admitted that the men of the Renaissance, though standing on the shoulders of the old philosophers, were a long time before they saw as much as their forerunners had done.

The first serious attempts to carry further the unfinished work of Archimedes, Hipparchus, and Ptolemy, of Aristotle and of Galen, naturally enough arose among the astronomers and the physicians. For the

imperious necessity of seeking some remedy for the physical ills of life had insured the preservation of more or less of the wisdom of Hippocrates and his successors; and, by a happy conjunction of circumstances, the Jewish and the Arabian physicians and philo[45]sophers escaped many of the influences which, at that time, blighted natural knowledge in the Christian world. On the other hand, the superstitious hopes and fears which afforded countenance to astrology and to alchemy also sheltered astronomy and the germs of chemistry. Whether for this, or for some better reason, the founders of the schools of the Middle Ages included astronomy, along with geometry, arithmetic, and music, as one of the four branches of advanced education; and, in this respect, it is only just to them to observe that they were far in advance of those who sit in their seats. The schoolmen considered no one to be properly educated unless he were acquainted with, at any rate, one branch of physical science. We have not, even yet, reached that stage of enlightenment.

In the early decades of the seventeenth century, the men of the Renaissance could show that they had already put out to good interest the treasure bequeathed to them by the Greeks. They had produced the astronomical system of Copernicus, with Kepler's great additions; the astronomical discoveries and the physical investigations of Galileo; the mechanics of Stevinus and the "De Magnete" of Gilbert; the anatomy of the great French and Italian schools and the physiology of Harvey. In Italy, which had succeeded Greece in the hegemony of the scientific world, the Accademia dei Lyncei and sundry other such [46] associations for the investigation of nature, the models of all subsequent academies and scientific societies, had been founded; while the literary skill and biting wit of Galileo had made the great scientific questions of the day not only intelligible, but attractive, to the general public.

In our own country, Francis Bacon had essayed to sum up the past of physical science, and to indicate the path which it must follow if its great destinies were to be fulfilled. And though the attempt was just such a magnificent failure as might have been expected from a man of great endowments, who was so singularly devoid of scientific insight that he could not understand the value of the work already achieved by the true instaurators of physical science; yet the majestic eloquence and the fervid vaticinations of one who was conspicuous alike by the greatness of his rise and the depth of his fall, drew the attention of all the world to the "new birth of Time."

But it is not easy to discover satisfactory evidence that the "Novum Organum" had any direct beneficial influence on the advancement of natural knowledge. No delusion is greater than the notion that method and industry can make up for lack of motherwit, either in science or in practical life; and it is strange that, with his knowledge of mankind, Bacon should have dreamed that his, or any other, "via inveniendi scientias" would "level men's wits" and leave [47] little scope for that inborn capacity which is called genius. As a matter of fact, Bacon's "via" has proved hopelessly impracticable; while the "anticipation of nature" by the invention of hypotheses based on incomplete inductions, which he specially condemns, has proved itself to be a most efficient, indeed an indispensable, instrument of scientific progress. Finally, that transcendental alchemy–the superinducement of new forms on matter–which Bacon declares to be the supreme aim of science, has been wholly ignored by those who have created the physical knowledge of the present day.

Even the eloquent advocacy of the Chancellor brought no unmixed good to physical science. It was

natural enough that the man who, in his better moments, took "all knowledge for his patrimony," but, in his worse, sold that birthright for the mess of pottage of Court favour and professional success, for pomp and show, should be led to attach an undue value to the practical advantages which he foresaw, as Roger Bacon and, indeed, Seneca had foreseen, long before his time, must follow in the train of the advancement of natural knowledge. The burden of Bacon's pleadings for science is the "gathering of fruit"–the importance of winning solid material advantages by the investigation of Nature and the desirableness of limiting the application of scientific methods of inquiry to that field.

[48] Bacon's younger contemporary, Hobbes, casting aside the prudent reserve of his predecessor in regard to those matters about which the Crown or the Church might have something to say, extended scientific methods of inquiry to the phenomena of mind and the problems of social organisation; while, at the same time, he indicated the boundary between the province of real, and that of imaginary, knowledge. The "Principles of Philosophy" and the "Leviathan" embody a coherent system of purely scientific thought in language which is a model of clear and vigorous English style. At the same time, in France, a man of far greater scientific capacity than either Bacon or Hobbes, René Descartes, not only in his immortal "Discours de la Méthode" and elsewhere, went down to the foundations of scientific certainty, but, in his "Principes de Philosophie," indicated where the goal of physical science really lay. However, Descartes was an eminent mathematician, and it would seem that the bent of his mind led him to overestimate the value of deductive reasoning from general principles, as much as Bacon had under-estimated it. The progress of physical science has been effected neither by Baconians nor by Cartesians, as such, but by men like Galileo and Harvey, Boyle and Newton, who would have done their work just as well if neither Bacon nor Descartes had ever propounded their views respecting the [49] manner in which scientific investigation should be pursued.

The progress of science, during the first century after Bacon's death, by no means verified his sanguine prediction of the fruits which it would yield. For, though the revived and renewed study of nature had spread and grown to an extent which surpassed reasonable expectation, the practical results–the "good to men's estate "–were, at first, by no means apparent. Sixty years after Bacon's death, Newton had crowned the long labours of the astronomers and the physicists, by co-ordinating the phenomena of molar motion throughout the visible universe into one vast system; but the "Principia" helped no man to either wealth or comfort. Descartes, Newton, and Leibnitz had opened up new worlds to the mathematician, but the acquisitions of their genius enriched only man's ideal estate. Descartes had laid the foundations of rational cosmogony and of physiological psychology; Boyle had produced models of experimentation in various branches of physics and chemistry; Pascal and Torricelli had weighed the air; Malpighi and Grew, Ray and Willoughby had done work of no less importance in the biological sciences; but weaving and spinning were carried on with the old appliances; nobody could travel faster by sea or by land than at any previous time in the world's history, and King George could send a message from London [50] to York no faster than King John might have done. Metals were worked from their ores by immemorial rule of thumb, and the centre of the iron trade of these islands was still among the oak forests of Sussex. The utmost skill of our mechanicians did not get beyond the production of a coarse watch.

The middle of the eighteenth century is illustrated by a host of great names in science–English, French,

German, and Italian–especially in the fields of chemistry, geology, and biology; but this deepening and broadening of natural knowledge produced next to no immediate practical benefits. Even if, at this time, Francis Bacon could have returned to the scene of his greatness and of his littleness, he must have regarded the philosophic world which praised and disregarded his precepts with great disfavour. If ghosts are consistent, he would have said, "These people are all wasting their time, just as Gilbert and Kepler and Galileo and my worthy physician Harvey did in my day. Where are the fruits of the restoration of science which I promised? This accumulation of bare knowledge is all very well, but *cui bono*? Not one of these people is doing what I told him specially to do, and seeking that secret of the cause of forms which will enable men to deal, at will, with matter, and superinduce new natures upon the old foundations."

[51] But, a little later, that growth of knowledge beyond imaginable utilitarian ends, which is the condition precedent of its practical utility, began to produce some effect upon practical life; and the operation of that part of nature we call human upon the rest began to create, not "new natures," in Bacon's sense, but a new Nature, the existence of which is dependent upon men's efforts, which is subservient to their wants, and which would disappear if man's shaping and guiding hand were withdrawn. Every mechanical artifice, every chemically pure substance employed in manufacture, every abnormally fertile race of plants, or rapidly growing and fattening breed of animals, is a part of the new Nature created by science. Without it, the most densely populated regions of modern Europe and America must retain their primitive, sparsely inhabited, agricultural or pastoral condition; it is the foundation of our wealth and the condition of our safety from submergence by another flood of barbarous hordes; it is the bond which unites into a solid political whole, regions larger than any empire of antiquity; it secures us from the recurrence of the pestilences and famines of former times; it is the source of endless comforts and conveniences, which are not mere luxuries, but conduce to physical and moral well-being. During the last fifty years, this new birth of time, this new Nature begotten by science upon fact, has pressed itself daily and hourly upon [52] our attention, and has worked miracles which have modified the whole fashion of our lives.

What wonder, then, if these astonishing fruits of the tree of knowledge are too often regarded by both friends and enemies as the be-all and end-all of science? What wonder if some eulogise, and others revile, the new philosophy for its utilitarian ends and its merely material triumphs?

In truth, the new philosophy deserves neither the praise of its eulogists, nor the blame of its slanderers. As I have pointed out, its disciples were guided by no search after practical fruits, during the great period of its growth, and it reached adolescence without being stimulated by any rewards of that nature. The bare enumeration of the names of the men who were the great lights of science in the latter part of the eighteenth and the first decade of the nineteenth century, of Herschel, of Laplace, of Young, of Fresnel, of Oersted, of Cavendish, of Lavoisier, of Davy, of Lamarck, of Cuvier, of Jussieu, of Decandolle, of Werner and of Hutton, suffices to indicate the strength of physical science in the age immediately preceding that of which I have to treat. But of which of these great men can it be said that their labours were directed to practical ends? I do not call to mind even an invention of practical utility which we owe to any of them, except the safety-lamp of Davy. Werner certainly paid attention to mining, and I have not forgotten [53] James Watt. But, though some of the most important of the

improvements by which Watt converted the steam-engine, invented long before his time, into the obedient slave of man, were suggested and guided by his acquaintance with scientific principles, his skill as a practical mechanician and the efficiency of Bolton's workmen had quite as much to do with the realisation of his projects.

In fact, the history of physical science teaches (and we cannot too carefully take the lesson to heart) that the practical advantages, attainable through its agency, never have been, and never will be, sufficiently attractive to men inspired by the inborn genius of the interpreter of Nature, to give them courage to undergo the toils and make the sacrifices which that calling requires from its votaries. That which stirs their pulses is the love of knowledge and the joy of the discovery of the causes of things sung by the old poet–the supreme delight of extending the realm of law and order ever farther towards the unattainable goals of the infinitely great and the infinitely small, between which our little race of life is run. In the course of this work, the physical philosopher, sometimes intentionally, much more often unintentionally, lights upon something which proves to be of practical value. Great is the rejoicing of those who are benefited thereby; and, for the moment, science is the Diana of all the [54] craftsmen. But, even while the cries of jubilation resound and this flotsam and jetsam of the tide of investigation is being turned into the wages of workmen and the wealth of capitalists, the crest of the wave of scientific investigation is far away on its course over the illimitable ocean of the unknown.

Far be it from me to depreciate the value of the gifts of science to practical life, or to cast a doubt upon the propriety of the course of action of those who follow science in the hope of finding wealth alongside truth, or even wealth alone. Such a profession is as respectable as any other. And quite as little do I desire to ignore the fact that, if industry owes a heavy debt to science, it has largely repaid the loan by the important aid which it has, in its turn, rendered to the advancement of science. In considering the causes which hindered the progress of physical knowledge in the schools of Athens and of Alexandria, it has often struck me[1] that where the Greeks did wonders was in just those branches of science, such as geometry, astronomy, and anatomy, which are susceptible of very considerable development without any, or any but the simplest, appliances. It is a curious speculation to think what would have become of modern physical science if glass and [55] alcohol had not been easily obtainable; and if the gradual perfection of mechanical skill for industrial ends had not enabled investigators to obtain, at comparatively little cost, microscopes, telescopes, and all the exquisitely delicate apparatus for determining weight and measure and for estimating the lapse of time with exactness, which they now command. If science has rendered the colossal development of modern industry possible, beyond a doubt industry has done no less for modern physics and chemistry, and for a great deal of modern biology. And as the captains of industry have, at last, begun to be aware that the condition of success in that warfare, under the forms of peace, which is known as industrial competition, lies in the discipline of the troops and the use of arms of precision, just as much as it does in the warfare which is called war, their demand for that discipline, which is technical education, is reacting upon science in a manner which will, assuredly, stimulate its future growth to an incalculable extent. It has become obvious that the interests of science and of industry are identical; that science cannot make a step forward without, sooner or later, opening up new channels for industry; and, on the other hand, that every advance of industry facilitates those experimental investigations, upon which the growth of science depends. We may hope that, at last, the weary misunderstanding between the practical men who [56] professed to

despise science, and the high and dry philosophers who professed to despise practical results, is at an end.

Nevertheless, that which is true of the infancy of physical science in the Greek world, that which is true of its adolescence in the seventeenth and eighteenth centuries, remains true of its riper age in these latter days of the nineteenth century. The great steps in its progress have been made, are made, and will be made, by men who seek knowledge simply because they crave for it. They have their weaknesses, their follies, their vanities, and their rivalries, like the rest of the world; but, whatever by-ends may mar their dignity and impede their usefulness, this chief end redeems them.[2] Nothing great in science has ever been done by men, whatever their powers, in whom the divine afflatus of the truth-seeker was wanting. Men of moderate capacity have [57] done great things because it animated them; and men of great natural gifts have failed, absolutely or relatively, because they lacked this one thing needful.

To any one who knows the business of investigation practically, Bacon's notion of establishing a company of investigators to work for "fruits," as if the pursuit of knowledge were a kind of mining operation and only required well-directed picks and shovels, seems very strange.[3] In science, as in art, and, as I believe, in every other sphere of human activity, there may be wisdom in a multitude of counsellors, but it is only in one or two of them. And, in scientific inquiry, at any rate, it is to that one or two that we must look for light and guidance. Newton said that he made his discoveries by "intending" his mind on the subject; no doubt, truly. But to equal his success one must have the mind which he "intended." Forty lesser men might have intended their minds till they cracked, without any like result. It would be idle either to affirm or to deny that the last half-century has produced men of science of the calibre of Newton. It is sufficient that it can show a few capacities of the first rank, competent not only to deal profitably with the inheritance [58] bequeathed by their scientific forefathers, but to pass on to their successors physical truths of a higher order than any yet reached by the human race. And if they have succeeded as Newton succeeded, it is because they have sought truth as he sought it, with no other object than the finding it.

I am conscious that in undertaking to give even the briefest sketch of the progress of physical science, in all its branches, during the last half-century, I may be thought to have exhibited more courage than discretion, and perhaps more presumption than either. So far as physical science is concerned, the days of Admirable Crichtons have long been over, and the most indefatigable of hard workers may think he has done well if he has mastered one of its minor subdivisions. Nevertheless, it is possible for any one, who has familiarised himself with the operations of science in one department, to comprehend the significance, and even to form a general estimate of the value, of the achievements of specialists in other departments.

Nor is there any lack either of guidance, or of aids to ignorance. By a happy chance, the first edition of Whewell's "History of the Inductive Sciences" was published in 1837, and it affords a very useful view of the state of things at the commencement of the Victorian epoch. As to subsequent events, [59] there are numerous excellent summaries of the progress of various branches of science, especially up to 1881, which was the jubilee year of the British Association.[4] And, with respect to the biological sciences, with

some parts of which my studies have familiarised me, my personal experience nearly coincides with the preceding half-century. I may hope, therefore, that my chance of escaping serious errors is as good as that of any one else, who might have been persuaded to undertake the somewhat perilous enterprise in which I find myself engaged.

There is yet another prefatory remark which it seems desirable I should make. It is that I think it proper to confine myself to the work done, without saying anything about the doers of it. Meddling with questions of merit and priority is a thorny business at the best of times, and, unless in case of necessity, altogether undesirable when one is dealing with contemporaries. No such necessity lies upon me; and I shall, therefore, mention no names of living men, lest, perchance, I should incur the reproof which the Israelites, who struggled with one another in the field, addressed to Moses–"Who made thee a prince and a judge over us?"

[60] Physical science is one and indivisible. Although, for practical purposes, it is convenient to mark it out into the primary regions of Physics, Chemistry, and Biology, and to subdivide these into subordinate provinces, yet the method of investigation and the ultimate object of the physical inquirer are everywhere the same.

The object is the discovery of the rational order which pervades the universe; the method consists of observation and experiment (which is observation under artificial conditions) for the determination of the facts of Nature; of inductive and deductive reasoning for the discovery of their mutual relations and connection. The various branches of physical science differ in the extent to which, at any given moment of their history, observation on the one hand, or ratiocination on the other, is their more obvious feature, but in no other way; and nothing can be more incorrect than the assumption one sometimes meets with, that physics has one method, chemistry another, and biology a third.

All physical science starts from certain postulates. One of them is the objective existence of a material world. It is assumed that the phenomena which are comprehended under this name have a "substratum" of extended, impenetrable, mobile substance, which exhibits the quality known as inertia, and is termed matter.[5] Another [61] postulate is the universality of the law of causation; that nothing happens without a cause (that is, a necessary precedent condition), and that the state of the physical universe, at any given moment, is the consequence of its state at any preceding moment. Another is that any of the rules, or so-called "laws of Nature," by which the relation of phenomena is truly defined, is true for all time. The validity of these postulates is a problem of metaphysics; they are neither self-evident nor are they, strictly speaking, demonstrable. The justification of their employment, as axioms of physical philosophy, lies in the circumstance that expectations logically based upon them are verified, or, at any rate, not contradicted, whenever they can be tested by experience.

Physical science therefore rests on verified or uncontradicted hypotheses; and, such being the case, it is not surprising that a great condition of [62] its progress has been the invention of verifiable hypotheses. It is a favourite popular delusion that the scientific inquirer is under a sort of moral obligation to abstain from going beyond that generalisation of observed facts which is absurdly called "Baconian" induction.

But any one who is practically acquainted with scientific work is aware that those who refuse to go beyond fact, rarely get as far as fact; and any one who has studied the history of science knows that almost every great step therein has been made by the "anticipation of Nature," that is, by the invention of hypotheses, which, though verifiable, often had very little foundation to start with; and, not unfrequently, in spite of a long career of usefulness, turned out to be wholly erroneous in the long run.

The geocentric system of astronomy, with its eccentrics and its epicycles, was an hypothesis utterly at variance with fact, which nevertheless did great things for the advancement of astronomical knowledge. Kepler was the wildest of guessers. Newton's corpuscular theory of light was of much temporary use in optics, though nobody now believes in it; and the undulatory theory, which has superseded the corpuscular theory and has proved one of the most fertile of instruments of research, is based on the hypothesis of the existence of an "ether," the properties of which are defined in propositions, [63] some of which, to ordinary apprehension, seem physical antinomies.

It sounds paradoxical to say that the attainment of scientific truth has been effected, to a great extent, by the help of scientific errors. But the subject-matter of physical science is furnished by observation, which cannot extend beyond the limits of our faculties; while, even within those limits, we cannot be certain that any observation is absolutely exact and exhaustive. Hence it follows that any given generalisation from observation may be true, within the limits of our powers of observation at a given time, and yet turn out to be untrue, when those powers of observation are directly or indirectly enlarged. Or, to put the matter in another way, a doctrine which is untrue absolutely, may, to a very great extent, be susceptible of an interpretation in accordance with the truth. At a certain period in the history of astronomical science, the assumption that the planets move in circles was true enough to serve the purpose of correlating such observations as were then possible; after Kepler, the assumption that they move in ellipses became true enough in regard to the state of observational astronomy at that time. We say still that the orbits of the planets are ellipses, because, for all ordinary purposes, that is a sufficiently near approximation to the truth; but, as a matter of fact, the centre of gravity of a planet describes [64] neither an ellipse nor any other simple curve, but an immensely complicated undulating line. It may fairly be doubted whether any generalisation, or hypothesis, based upon physical data is absolutely true, in the sense that a mathematical proposition is so; but, if its errors can become apparent only outside the limits of practicable observation, it may be just as usefully adopted for one of the symbols of that algebra by which we interpret Nature, as if it were absolutely true.

The development of every branch of physical knowledge presents three stages, which, in their logical relation, are successive. The first is the determination of the sensible character and order of the phenomena. This is *Natural Philosophy,* in the original sense of the term, and here nothing but observation and experiment avail us. The second is the determination of the constant relations of the phenomena thus defined, and their expression in rules or laws. The third is the explication of these particular laws by deduction from the most general laws of matter and motion. The last two stages constitute *Natural Philosophy* in its original sense. In this region, the invention of verifiable hypotheses is not only permissible, but is one of the conditions of progress.

Historically, no branch of science has followed this order of growth; but, from the dawn of exact

knowledge to the present day, observation, experi[65]ment, and speculation have gone hand in hand; and, whenever science has halted or strayed from the right path, it has been, either because its votaries have been content with mere unverified or unverifiable speculation (and this is the commonest case, because observation and experiment are hard work, while speculation is amusing); or it has been, because the accumulation of details of observation has for a time excluded speculation.

The progress of physical science, since the revival of learning, is largely due to the fact that men have gradually learned to lay aside the consideration of unverifiable hypotheses; to guide observation and experiment by verifiable hypotheses; and to consider the latter, not as ideal truths, the real entities of an intelligible world behind phenomena, but as a symbolical language, by the aid of which Nature can be interpreted in terms apprehensible by our intellects. And if physical science, during the last fifty years, has attained dimensions beyond all former precedent, and can exhibit achievements of greater importance than any former such period can show, it is because able men, animated by the true scientific spirit, carefully trained in the method of science, and having at their disposal immensely improved appliances, have devoted themselves to the enlargement of the boundaries of natural knowledge in greater number than during any previous half-century of the world's history.

[66] I have said that our epoch can produce achievements in physical science of greater moment than any other has to show, advisedly; and I think that there are three great products of our time which justify the assertion. One of these is that doctrine concerning the constitution of matter which, for want of a better name, I will call "molecular;" the second is the doctrine of the conservation of energy; the third is the doctrine of evolution. Each of these was foreshadowed, more or less distinctly, in former periods of the history of science; and, so far is either from being the outcome of purely inductive reasoning, that it would be hard to overrate the influence of metaphysical, and even of theological, considerations upon the development of all three. The peculiar merit of our epoch is that it has shown how these hypotheses connect a vast number of seemingly independent partial generalisations; that it has given them that precision of expression which is necessary for their exact verification; and that it has practically proved their value as guides to the discovery of new truth. All three doctrines are intimately connected, and each is applicable to the whole physical cosmos. But, as might have been expected from the nature of the case, the first two grew, mainly, out of the consideration of physico-chemical phenomena; while the third, in great measure, owes its rehabilitation, if not its origin, to the study of biological phenomena.

[67] In the early decades of this century, a number of important truths applicable, in part, to matter in general, and, in part, to particular forms of matter, had been ascertained by the physicists and chemists.

The laws of motion of visible and tangible, or *molar*, matter had been worked out to a great degree of refinement and embodied in the branches of science known as Mechanics, Hydrostatics, and Pneumatics. These laws had been shown to hold good, so far as they could be checked by observation and experiment, throughout the universe, on the assumption that all such masses of matter possessed inertia and were susceptible of acquiring motion, in two ways, firstly by impact, or impulse from without; and, secondly, by the operation of certain hypothetical causes of motion termed "forces," which were usually supposed to be resident in the particles of the masses themselves, and to operate at a distance, in such a way as to tend to draw any two such masses together, or to separate them more

widely.

With respect to the ultimate constitutions of these masses, the same two antagonistic opinions which had existed since the time of Democritus and of Aristotle were still face to face. According to the one, matter was discontinuous and consisted of minute indivisible particles or atoms, separated by a universal vacuum; according to the other, it was continuous, and the finest distinguishable, or [68] imaginable, particles were scattered through the attenuated general substance of the plenum. A rough analogy to the latter case would be afforded by granules of ice diffused through water; to the former, such granules diffused through absolutely empty space.

In the latter part of the eighteenth century, the chemists had arrived at several very important generalisations respecting those properties of matter with which they were especially concerned. However plainly ponderable matter seemed to be originated and destroyed in their operations, they proved that, as mass or body, it remained indestructible and ingenerable; and that, so far, it varied only in its perceptibility by our senses. The course of investigation further proved that a certain number of the chemically separable kinds of matter were unalterable by any known means (except in so far as they might be made to change their state from solid to fluid, or *vice versa*), unless they were brought into contact with other kinds of matter, and that the properties of these several kinds of matter were always the same, whatever their origin. All other bodies were found to consist of two or more of these, which thus took the place of the four "elements" of the ancient philosophers. Further, it was proved that, in forming chemical compounds, bodies always unite in a definite proportion by weight, or in simple multiples of that proportion, and that, if any one [69] body were taken as a standard, every other could have a number assigned to it as its proportional combining weight. It was on this foundation of fact that Dalton based his re-establishment of the old atomic hypothesis on a new empirical foundation. It is obvious, that if elementary matter consists of indestructible and indivisible particles, each of which constantly preserves the same weight relatively to all the others, compounds formed by the aggregation of two, three, four, or more such particles must exemplify the rule of combination in definite proportions deduced from observation.

In the meanwhile, the gradual reception of the undulatory theory of light necessitated the assumption of the existence of an "ether" filling all space. But whether this ether was to be regarded as a strictly material and continuous substance, was an undecided point, and hence the revived atomism escaped strangling in its birth. For it is clear, that if the ether is admitted to be a continuous material substance, Democritic atomism is at an end and Cartesian continuity takes its place.

The real value of the new atomic hypothesis, however, did not lie in the two points which Democritus and his followers would have considered essential–namely, the indivisibility of the "atoms" and the presence of an interatomic vacuum–but in the assumption that, to the [70] extent to which our means of analysis take us, material bodies consist of definite minute masses, each of which, so far as physical and chemical processes of division go, may be regarded as a unit having a practically permanent individuality. Just as a man is the unit of sociology, without reference to the actual fact of his divisibility, so such a minute mass is the unit of physico-chemical science–that smallest material particle

which under any given circumstances acts as a whole.[6]

The doctrine of specific heat originated in the eighteenth century. It means that the same mass of a body, under the same circumstances, always requires the same quantity of heat to raise it to a given temperature, but that equal masses of different bodies require different quantities. Ultimately, it was found that the quantities of heat required to raise equal masses of the more perfect gases, through equal ranges of temperature, were inversely proportional to their combining weights. Thus a definite relation was established between the hypothetical units and heat. The phenomena of electrolytic decomposition showed that there was a like close relation between these units and electricity. The quantity of electricity generated by the combination of any two units is sufficient to separate any other two which are susceptible of [71] such decomposition. The phenomena of isomorphism showed a relation between the units and crystalline forms; certain units are thus able to replace others in a crystalline body without altering its form, and others are not.

Again, the laws of the effect of pressure and heat on gaseous bodies, the fact that they combine in definite proportions by volume, and that such proportion bears a simple relation to their combining weights, all harmonised with the Daltonian hypothesis, and led to the bold speculation known as the law of Avogadro–that all gaseous bodies, under the same physical conditions, contain the same number of units. In the form in which it was first enunciated, this hypothesis was incorrect–perhaps it is not exactly true in any form; but it is hardly too much to say that chemistry and molecular physics would never have advanced to their present condition unless it had been assumed to be true. Another immense service rendered by Dalton, as a corollary of the new atomic doctrine, was the creation of a system of symbolic notation, which not only made the nature of chemical compounds and processes easily intelligible and easy of recollection, but, by its very form, suggested new lines of inquiry. The atomic notation was as serviceable to chemistry as the binomial nomenclature and the classificatory schematism of Linnæus were to zoology and botany.

Side by side with these advances arose another, [72] which also has a close parallel in the history of biological science. If the unit of a compound is made up by the aggregation of elementary units, the notion that these must have some sort of definite arrangement inevitably suggests itself; and such phenomena as double decomposition pointed, not only to the existence of a molecular architecture, but to the possibility of modifying a molecular fabric without destroying it, by taking out some of the component units and replacing them by others. The class of neutral salts, for example, includes a great number of bodies in many ways similar, in which the basic molecules, or the acid molecules, may be replaced by other basic and other acid molecules, without altering the neutrality of the salt; just as a cube of bricks remains a cube, so long as any brick that is taken out is replaced by another of the same shape and dimensions whatever its weight or other properties may be. Facts of this kind gave rise to the conception of "types" of molecular structure, just as the recognition of the unity in diversity of the structure of the species of plants and animals gave rise to the notion of biological "types." The notation of chemistry enabled these ideas to be represented with precision; and they acquired an immense importance, when the improvement of methods of analysis, which took place about the beginning of our period, enabled the composition of the so-called "organic" bodies to be determined [73] with rapidity

and precision.[7] A large proportion of these compounds contain not more than three or four elements, of which carbon is the chief; but their number is very great, and the diversity of their physical and chemical properties is astonishing. The ascertainment of the proportion of each element in these compounds affords little or no help towards accounting for their diversities; widely different bodies being often very similar, or even identical, in that respect. And, in the last case, that of *isomeric* compounds, the appeal to diversity of arrangement of the identical component units was the only obvious way out of the difficulty. Here, again, hypothesis proved to be of great value; not only was the search for evidence of diversity of molecular structure successful, but the study of the process of taking to pieces led to the discovery of the way to put together; and vast numbers of compounds, some of them previously known only as products of the living economy, have thus been artificially constructed. Chemical work, at the present day, is, to a large extent, synthetic or creative–that is to say, the chemist determines, theoretically, that certain non-existent compounds ought to be producible, and he proceeds to produce them.

It is largely because the chemical theory and [74] practice of our epoch have passed into this deductive and synthetic stage, that they are entitled to the name of the "New Chemistry" which they commonly receive. But this new Chemistry has grown up by the help of hypotheses, such as those of Dalton and of Avogadro, and that singular conception of "bonds" invented to colligate the facts of "valency" or "atomicity," the first of which took some time to make its way; while the second fell into oblivion, for many years after it was propounded, for lack of empirical justification. As for the third, it may be doubted if any one regards it as more than a temporary contrivance.

But some of these hypotheses have done yet further service. Combining them with the mechanical theory of heat and the doctrine of the conservation of energy, which are also products of our time, physicists have arrived at an entirely new conception of the nature of gaseous bodies and of the relation of the physico-chemical units of matter to the different forms of energy. The conduct of gases under varying pressure and temperature, their diffusibility, their relation to radiant heat and to light, the evolution of heat when bodies combine, the absorption of heat when they are dissociated, and a host of other molecular phenomena, have been shown to be deducible from the dynamical and statical principles which apply to molar motion and rest; and the tendency of physico-chemical science is clearly towards the [75] reduction of the problems of the world of the infinitely little, as it already has reduced those of the infinitely great world, to questions of mechanics.[8]

In the meanwhile, the primitive atomic theory, which has served as the scaffolding for the edifice of modern physics and chemistry, has been quietly dismissed. I cannot discover that any contemporary physicist or chemist believes in the real indivisibility of atoms, or in an interatomic matterless vacuum. The term "atoms" appears to be used as a mere name for physico-chemical units which have not yet been subdivided, and "molecules" for physico-chemical units which are aggregates of the former. And these individualised particles are supposed to move in an endless ocean of a vastly more subtle matter–the ether. If this ether is a continuous substance, therefore, we have got back from the hypothesis of Dalton to that of Descartes. But there is much reason to believe that science is going to make a still further journey, and, in form, if not altogether in substance, to return to the point of view of Aristotle.

The greater number of the so-called "elementary" bodies, now known, had been discovered before the commencement of our epoch; and it had become apparent that they were by no means [76] equally similar or dissimilar, but that some of them, at any rate, constituted groups, the several members of which were as much like one another as they were unlike the rest. Chlorine, iodine, bromine, and fluorine thus formed a very distinct group; sulphur and selenium another; boron and silicon another; potassium, sodium, and lithium another; and so on. In some cases, the atomic weights of such allied bodies were nearly the same, or could be arranged in series, with like differences between the several terms. In fact, the elements afforded indications that they were susceptible of a classification in natural groups, such as those into which animals and plants fall.

Recently this subject has been taken up afresh, with a result which may be stated roughly in the following terms. If the sixty-five or sixty-eight recognised "elements" are arranged in the order of their atomic weights–from hydrogen, the lightest, as unity, to uranium, the heaviest, as 240–the series does not exhibit one continuous progressive modification in the physical and chemical characters of its several terms, but breaks up into a number of sections, in each of which the several terms present analogies with the corresponding terms of the other series.

Thus, the whole series does not run

a, b, c, d, e, f, g, h, i, k, &c.,

but

a, b, c, d, A, B, C, D, α, β, γ, δ, &c.

[77] so that it is said to express a *periodic law* of recurrent similarities. Or the relation may be expressed in another way. In each section of the series, the atomic weight is greater than in the preceding section, so that if *w* is the atomic weight of any element in the first segment, *w* + *x* will represent the atomic weight of any element in the next, and *w* + *y* the atomic weight of any element in the next, and so on. Therefore the sections may be represented as parallel series, the corresponding terms of which have analogous properties; each successive series starting with a body the atomic weight of which is greater than that of any in the preceding series, in the following fashion:

d	D	δ
c	C	γ
b	B	β
a	A	α
—	———	—————————
w	*w*+*x*	*w*+*x*+*y*

This is a conception with which biologists are very familiar, animal and plant groups constantly appearing as series of parallel modifications of similar and yet different primary forms. In the living world, facts of this kind are now understood to mean evolution from a common prototype. It is difficult to imagine that in the not-living world they are devoid of significance. Is it not possible, nay, probable, that they may mean the evolution of our "elements" from a primary undifferen[78]tiated form of matter? Fifty years ago, such a suggestion would have been scouted as a revival of the dreams of the alchemists. At present, it may be said to be the burning question of physicochemical science.

In fact, the so-called "vortex-ring" hypothesis is a very serious and remarkable attempt to deal with material units from a point of view which is consistent with the doctrine of evolution. It supposes the ether to be a uniform substance, and that the "elementary" units are, broadly speaking, permanent whirlpools, or vortices, of this ether, the properties of which depend on their actual and potential modes of motion. It is curious and highly interesting to remark that this hypothesis reminds us not only of the speculations of Descartes, but of those of Aristotle. The resemblance of the "vortex-rings" to the "tourbillons" of Descartes is little more than nominal; but the correspondence between the modern and the ancient notion of a distinction between primary and derivative matter is, to a certain extent, real. For this ethereal "Urstoff" of the modern corresponds very closely with the [primary matter] of Aristotle, the *materia prima* of his mediæval followers; while matter, differentiated into our elements, is the equivalent of the first stage of progress towards the [...] finished matter, of the ancient philosophy.

If the material units of the existing order of [79] Nature are specialised portions of a relatively homogeneous *materia prima*– which were originated under conditions that have long ceased to exist and which remain unchanged and unchangeable under all conditions, whether natural or artificial, hitherto known to us–it follows that the speculation that they may be indefinitely altered, or that new units may be generated under conditions yet to be discovered, is perfectly legitimate. Theoretically, at any rate, the transmutability of the elements is a verifiable scientific hypothesis; and such inquiries as those which have been set afoot, into the possible dissociative action of the great heat of the sun upon our elements, are not only legitimate, but are likely to yield results which, whether affirmative or negative, will be of great importance. The idea that atoms are absolutely ingenerable and immutable "manufactured articles" stands on the same sort of foundation as the idea that biological species are "manufactured articles" stood thirty years ago; and the supposed constancy of the elementary atoms, during the enormous lapse of time measured by the existence of our universe, is of no more weight against the possibility of change in them, in the infinity of antecedent time, than the constancy of species in Egypt, since the days of Rameses or of Cheops, is evidence of their immutability during all past epochs of the earth's history. It seems safe to [80] prophesy that the hypothesis of the evolution of the elements from a primitive matter will, in future, play no less a part in the history of science than the atomic hypothesis, which, to begin with, had no greater, if so great, an empirical foundation.

It may perhaps occur to the reader that the boasted progress of physical science does not come to much, if our present conceptions of the fundamental nature of matter are expressible in terms employed, more than two thousand years ago, by the old "master of those that know." Such a criticism, however, would involve forgetfulness of the fact, that the connotation of these terms, in the mind of the modern, is almost infinitely different from that which they possessed in the mind of the ancient philosopher. In

antiquity, they meant little more than vague speculation; at the present day, they indicate definite physical conceptions, susceptible of mathematical treatment, and giving rise to innumerable deductions, the value of which can be experimentally tested. The old notions produced little more than floods of dialectics; the new are powerful aids towards the increase of solid knowledge.

Everyday observation shows that, of the bodies which compose the material world, some are in motion and some are, or appear to be, at rest. Of the bodies in motion, some, like the sun and stars, [81] exhibit a constant movement, regular in amount and direction, for which no external cause appears. Others, as stones and smoke, seem also to move of themselves when external impediments are taken away. But these appear to tend to move in opposite directions: the bodies we call heavy, such as stones, downwards, and the bodies we call light, at least such as smoke and steam, upwards. And, as we further notice that the earth, below our feet, is made up of heavy matter, while the air, above our heads, is extremely light matter, it is easy to regard this fact as evidence that the lower region is the place to which heavy things tend–their proper place, in short–while the upper region is the proper place of light things; and to generalise the facts observed by saying that bodies, which are free to move, tend towards their proper places. All these seem to be natural motions, dependent on the inherent faculties, or tendencies, of bodies themselves. But there are other motions, which are artificial or violent, as when a stone is thrown from the hand, or is knocked by another stone in motion. In such cases as these, for example, when a stone is cast from the hand, the distance travelled by the stone appears to depend partly on its weight, and partly upon the exertion of the thrower. So that, the weight of the stone remaining the same, it looks as if the motive power communicated to it were measured by the distance to which the stone travels–as if, in other words, [82] the power needed to send it a hundred yards was twice as great as that needed to send it fifty yards. These, apparently obvious conclusions from the everyday appearances of rest and motion fairly represent the state of opinion upon the subject which prevailed among the ancient Greeks, and remained dominant until the age of Galileo. The publication of the "Principia" of Newton, in 1686-7, marks the epoch at which the progress of mechanical physics had effected a complete revolution of thought on these subjects. By this time, it had been made clear that the old generalisations were either incomplete or totally erroneous; that a body, once set in motion, will continue to move in a straight line for any conceivable time or distance, unless it is interfered with; that any change of motion is proportional to the "force" which causes it, and takes place in the direction in which that "force" is exerted; and that, when a body in motion acts as a cause of motion on another, the latter gains as much as the former loses, and *vice versa.* It is to be noted, however, that while, in contradistinction to the ancient idea of the inherent tendency to motion of bodies, the absence of any such spontaneous power of motion was accepted as a physical axiom by the moderns, the old conception virtually maintained itself in a new shape. For, in spite of Newton's well-known warning against the "absurdity" of supposing that one body can act [83] on another at a distance through a vacuum, the ultimate particles of matter were generally assumed to be the seats of perennial causes of motion termed "attractive and repulsive forces," in virtue of which, any two such particles, without any external impression of motion, or intermediate material agent, were supposed to tend to approach or remove from one another: and this view of the duality of the causes of motion is very widely held at the present day.

Another important result of investigation, attained in the seventeenth century, was the proof and quantitative estimation of physical inertia. In the old philosophy, a curious conjunction of ethical and

physical prejudices had led to the notion that there was something ethically bad and physically obstructive about matter. Aristotle attributes all irregularities and apparent dysteleologies in nature to the disobedience, or sluggish yielding, of matter to the shaping and guiding influence of those reasons and causes which were hypostatised in his ideal "Forms." In modern science, the conception of the inertia, or resistance to change, of matter is complex. In part, it contains a corollary from the law of causation: A body cannot change its state in respect of rest or motion without a sufficient cause. But, in part, it contains generalisations from experience. One of these is that there is no such sufficient cause resident in any body, and that therefore it will rest, or continue [84] in motion, so long as no external cause of change acts upon it. The other is that the effect which the impact of a body in motion produces upon the body on which it impinges depends, other things being alike, on the relation of a certain quality of each which is called "mass." Given a cause of motion of a certain value, the amount of motion, measured by distance travelled in a certain time, which it will produce in a given quantity of matter, say a cubic inch, is not always the same, but depends on what that matter is–a cubic inch of iron will go faster than a cubic inch of gold. Hence, it appears, that since equal amounts of motion have, *ex hypothesi,* been produced, the amount of motion in a body does not depend on its speed alone, but on some property of the body. To this the name of "mass" has been given. And, since it seems reasonable to suppose that a large quantity of matter, moving slowly, possesses as much motion as a small quantity moving faster, "mass" has been held to express "quantity of matter." It is further demonstrable that, at any given time and place, the relative mass of any two bodies is expressed by the ratio of their weights.

When all these great truths respecting molar motion, or the movements of visible and tangible masses, had been shown to hold good not only of terrestrial bodies, but of all those which constitute the visible universe; and the movements of the macrocosm had thus been expressed by a general [85] mechanical theory, there remained a vast number of phenomena, such as those of light, heat, electricity, magnetism, and those of the physical and chemical changes which do not involve molar motion. Newton's corpuscular theory of light was an attempt to deal with one great series of these phenomena on mechanical principles, and it maintained its ground until, at the beginning of the nineteenth century, the undulatory theory proved itself to be a much better working hypothesis. Heat, up to that time, and indeed much later, was regarded as an imponderable substance, *caloric;* as a thing which was absorbed by bodies when they were warmed, and was given out as they cooled; and which, moreover, was capable of entering into a sort of chemical combination with them, and so becoming latent. Rumford and Davy had given a great blow to this view of heat by proving that the quantity of heat which two portions of the same body could be made to give out, by rubbing them together, was practically illimitable. This result brought philosophers face to face with the contradiction of supposing that a finite body could contain an infinite quantity of another body; but it was not until 1843, that clear and unquestionable experimental proof was given of the fact that there is a definite relation between mechanical work and heat; that so much [86] work always gives rise, under the same conditions, to so much heat, and so much heat to so much mechanical work. Thus originated the mechanical theory of heat, which became the starting point of the modern doctrine of the conservation of energy. Molar motion had appeared to be destroyed by friction. It was proved that no destruction took place, but that an exact equivalent of the energy of the lost molar motion appears as that of the *molecular* motion, or motion of the smallest particles of a body, which constitutes heat. The loss of the masses is the gain of their particles.

Before 1843, however, the doctrine of the conservation of energy had been approached. Bacon's chief contribution to positive science is the happy guess (for the context shows that it was little more) that heat may be a mode of motion; Descartes affirmed the quantity of motion in the world to be constant; Newton nearly gave expression to the complete theorem; while Rumford's and Davy's experiments suggested, though they did not prove, the equivalency of mechanical and thermal energy. Again, the discovery of voltaic electricity, and the marvellous development of knowledge, in that field, effected by such men as Davy, Faraday, Oersted, Ampere, and Melloni, had brought to light a number of facts which tended to show that the so-called "forces" at work in light, heat, electricity, and magnetism, in chemical and in mechanical operations, were intimately, and, in various cases, quantitatively, related. It was demonstrated that any one could [87] be obtained at the expense of any other; and apparatus was devised which exhibited the evolution of all these kinds of action from one source of energy. Hence the idea of the "correlation of forces" which was the immediate forerunner of the doctrine of the conservation of energy.

It is a remarkable evidence of the greatness of the progress in this direction which has been effected in our time, that even the second edition of the "History of the Inductive Sciences," which was published in 1846, contains no allusion either to the general view of the "Correlation of Forces" published in England in 1842, or to the publication in 1843 of the first of the series of experiments by which the mechanical equivalent of heat was correctly ascertained.[9] Such a failure on the part of a contemporary, of great acquirements and remarkable intellectual powers, to read the signs of the times, is a lesson and a warning worthy of being deeply pondered by any one who [88] attempts to prognosticate the course of scientific progress.

I have pointed out that the growth of clear and definite views respecting the constitution of matter has led to the conclusion that, so far as natural agencies are concerned, it is ingenerable and indestructible. In so far as matter may be conceived to exist in a purely passive state, it is, imaginably, older than motion. But, as it must be assumed to be susceptible of motion, a particle of bare matter at rest must be endowed with the potentiality of motion. Such a particle, however, by the supposition, can have no energy, for there is no cause why it should move. Suppose now that it receives an impulse, it will begin to move with a velocity inversely proportional to its mass, on the one hand, and directly proportional to the strength of the impulse, on the other, and will possess *kinetic energy*, in virtue of which it will not only continue to move for ever if unimpeded, but if it impinges on another such particle, it will impart more or less of its motion to the latter. Let it be conceived that the particle acquires a tendency to move, and that nevertheless it does not move. It is then in a condition totally different from that in which it was at first. A cause competent to produce motion is operating upon it, but, for some reason or other, is unable to give rise to motion. If the obstacle is removed, the energy which was there, but could not manifest itself at [89] once gives rise to motion. While the restraint lasts, the energy of the particle is merely potential; and the case supposed illustrates what is meant by *potential energy*. In this contrast of the potential with the actual, modern physics is turning to account the most familiar of Aristotelian distinctions–that between [power] and [energy].

That kinetic energy appears to be imparted by impact is a fact of daily and hourly experience: we see

bodies set in motion by bodies, already in motion, which seem to come in contact with them. It is a truth which could have been learned by nothing but experience, and which cannot be explained, but must be taken as an ultimate fact about which, explicable or inexplicable, there can be no doubt. Strictly speaking, we have no direct apprehension of any other cause of motion. But experience furnishes innumerable examples of the production of kinetic energy in a body previously at rest, when no impact is discernible as the cause of that energy. In all such cases, the presence of a second body is a necessary condition; and the amount of kinetic energy, which its presence enables the first to gain, is strictly dependent on the relative positions of the two. Hence the phrase *energy of position,* which is frequently used as equivalent to potential energy. If a stone is picked up and held, say, six feet above the ground, it has *potential energy,* because, if let go, it will immediately begin to move towards the earth; [90] and this energy may be said to be *energy of position,* because it depends upon the relative position of the earth and the stone. The stone is solicited to move but cannot, so long as the muscular strength of the holder prevents the solicitation from taking effect. The stone, therefore, has potential energy, which becomes kinetic if it is let go, and the amount of that kinetic energy which will be developed before it strikes the earth depends on its position–on the fact that it is, say, six feet off the earth, neither more nor less. Moreover. it can be proved that the raiser of the stone had to exert as much energy in order to place it in its position, as it will develop in falling. Hence the energy which was exerted, and apparently exhausted, in raising the stone, is potentially in the stone, in its raised position, and will manifest itself when the stone is set free. Thus the energy, withdrawn from the general stock to raise the stone, is returned when it falls, and there is no change in the total amount. Energy, as a whole, is conserved.

Taking this as a very broad and general statement of the essential facts of the case, the raising of the stone is intelligible enough, as a case of the communication of motion from one body to another. But the potential energy of the raised stone is not so easily intelligible. To all appearance, there is nothing either pushing or pulling it [91] towards the earth, or the earth towards it; and yet it is quite certain that the stone tends to move towards the earth and the earth towards the stone, in the way defined by the law of gravitation.

In the currently accepted language of science, the cause of motion, in all such cases as this, when bodies tend to move towards or away from one another, without any discernible impact of other bodies, is termed a "force," which is called "attractive" in the one case, and "repulsive" in the other. And such attractive or repulsive forces are often spoken of as if they were real things, capable of exerting a pull, or a push, upon the particles of matter concerned. Thus the potential energy of the stone is commonly said to be due to the "force" of gravity which is continually operating upon it.

Another illustration may make the case plainer. The bob of a pendulum swings first to one side and then to the other of the centre of the arc which it describes. Suppose it to have just reached the summit of its right-hand half-swing. It is said that the "attractive forces" of the bob for the earth, and of the earth for the bob, set the former in motion; and as these "forces" are continually in operation, they confer an accelerated velocity on the bob; until, when it reaches the centre of its swing, it is, so to speak, fully charged with kinetic energy. If, at this moment, the whole material universe, except the bob, were abolished, it would move for ever in the direction of a tangent to the middle of the arc described. [92] As a matter of fact, it is compelled to travel through its left-hand half-swing, and thus virtually to go up hill.

Consequently, the "attractive forces of the bob and the earth are now acting against it, and constitute a resistance which the charge of kinetic energy has to overcome. But, as this charge represents the operation of the attractive forces during the passage of the bob through the right-hand half-swing down to the centre of the arc, so it must needs be used up by the passage of the bob upwards from the centre of the arc to the summit of the left-hand half-swing. Hence, at this point, the bob comes to a momentary rest. The last fraction of kinetic energy is just neutralised by the action of the attractive forces, and the bob has only potential energy equal to that with which it started. So that the sum of the phenomena may be stated thus: At the summit of either half-arc of its swing, the bob has a certain amount of potential energy; as it descends it gradually exchanges this for kinetic energy, until at the centre it possesses an equivalent amount of kinetic energy; from this point onwards, it gradually loses kinetic energy as it ascends until, at the summit of the other half-arc, it has acquired an exactly similar amount of potential energy. Thus, on the whole transaction, nothing is either lost or gained; the quantity of energy is always the same, but it passes from one form into the other.

[93] To all appearance, the phenomena exhibited by the pendulum are not to be accounted for by impact: in fact, it is usually assumed that corresponding phenomena would take place if the earth and the pendulum were situated in an absolute vacuum, and at any conceivable distance from one another. If this be so, it follows that there must be two totally different kinds of causes of motion: the one impact–*a vera causa,* of which, to all appearance, we have constant experience; the other, attractive or repulsive "force"–a metaphysical entity which is physically inconceivable. Newton expressly repudiated the notion of the existence of attractive forces, in the sense in which that term is ordinarily understood; and he refused to put forward any hypothesis as to the physical cause of the so-called "attraction of gravitation." As a general rule, his successors have been content to accept the doctrine of attractive and repulsive forces, without troubling themselves about the philosophical difficulties which it involves. But this has not always been the case; and the attempt of Le Sage, in the last century, to show that the phenomena of attraction and repulsion are susceptible of explanation by his hypothesis of bombardment by ultramundane particles, whether tenable or not, has the great merit of being an attempt to get rid of the dual conception of the causes of motion which has hitherto prevailed. On this hypothesis, the [94] hammering of the ultra-mundane corpuscles on the bob confers its kinetic energy, on the one hand, and takes it away on the other; and the state of potential energy means the condition of the bob during the instant at which the energy, conferred by the hammering during the one half-arc, has just been exhausted by the hammering during the other half-arc. It seems safe to look forward to the time when the conception of attractive and repulsive forces, having served its purpose as a useful piece of scientific scaffolding, will be replaced by the deduction of the phenomena known as attraction and repulsion, from the general laws of motion.

The doctrine of the conservation of energy which I have endeavoured to illustrate is thus defined by the late Clerk Maxwell:

"The total energy of any body or system of bodies is a quantity which can neither be increased nor diminished by any mutual action of such bodies, though it may be transformed into any one of the forms of which energy is susceptible." It follows that energy, like matter, is indestructible and ingenerable in nature. The phenomenal world, so far as it is material, expresses the evolution and involution of energy,

its passage from the kinetic to the potential condition and back again. Wherever motion of matter takes place, that motion is effected at the expense of part of the total store of energy.

[95] Hence, as the phenomena exhibited by living beings, in so far as they are material, are all molar or molecular motions, these are included under the general law. A living body is a machine by which energy is transformed in the same sense as a steam-engine is so, and all its movements, molar and molecular, are to be accounted for by the energy which is supplied to it. The phenomena of consciousness which arise, along with certain transformations of energy, cannot be interpolated in the series of these transformations, inasmuch as they are not motions to which the doctrine of the conservation of energy applies. And, for the same reason, they do not necessitate the using up of energy; a sensation has no mass and cannot be conceived to be susceptible of movement. That a particular molecular motion does give rise to a state of consciousness is experimentally certain; but the how and why of the process are just as inexplicable as in the case of the communication of kinetic energy by impact.

When dealing with the doctrine of the ultimate constitution of matter, we found a certain resemblance between the oldest speculations and the newest doctrines of physical philosophers. But there is no such resemblance between the ancient and modern views of motion and its causes, except in so far as the conception of attractive and repulsive forces may be regarded as the modified descendant of the Aristotelian conception of forms. [96] In fact, it is hardly too much to say that the essential and fundamental difference between ancient and modern physical science lies in the ascertainment of the true laws of statics and dynamics in the course of the last three centuries; and in the invention of mathematical methods of dealing with all the consequences of these laws. The ultimate aim of modern physical science is the deduction of the phenomena exhibited by material bodies from physico-mathematical first principles. Whether the human intellect is strong enough to attain the goal set before it may be a question, but thither will it surely strive.

The third great scientific event of our time, the rehabilitation of the doctrine of evolution, is part of the same tendency of increasing knowledge to unify itself, which has led to the doctrine of the conservation of energy. And this tendency, again is mainly a product of the increasing strength conferred by physical investigation on the belief in the universal validity of that orderly relation of facts, which we express by the so-called "Laws of Nature."

The growth of a plant from its seed, of an animal from its egg, the apparent origin of innumerable living things from mud, or from the putrefying remains of former organisms, had furnished the earlier scientific thinkers with [97] abundant analogies suggestive of the conception of a corresponding method of cosmic evolution from a formless "chaos" to an ordered world which might either continue for ever or undergo dissolution into its elements before starting on a new course of evolution. It is therefore no wonder that, from the days of the Ionian school onwards, the view that the universe was the result of such a process should have maintained itself as a leading dogma of philosophy. The emanistic theories which played so great a part in Neoplatonic philosophy and in Gnostic theology are forms of evolution. In the seventeenth century, Descartes propounded a scheme of evolution, as an hypothesis of what might have been the mode of origin of the world, while professing to accept the ecclesiastical scheme of

creation, as an account of that which actually was its manner of coming into existence. In the eighteenth century, Kant put forth a remarkable speculation as to the origin of the solar system, closely similar to that subsequently adopted by Laplace and destined to become famous under the title of the "nebular hypothesis."

The careful observations and the acute reasonings of the Italian geologists of the seventeenth and eighteenth centuries; the speculations of Leibnitz in the "Protogæa" and of Buffon in his "Théorie de la Terre;" the sober and profound reasonings of Hutton, in the latter part of the [98] eighteenth century; all these tended to show that the fabric of the earth itself implied the continuation of processes of natural causation for a period of time as great, in relation to human history, as the distances of the heavenly bodies from us are, in relation to terrestrial standards of measurement. The abyss of time began to loom as large as the abyss of space. And this revelation to sight and touch, of a link here and a link there of a practically infinite chain of natural causes and effects, prepared the way, as perhaps nothing else has done, for the modern form of the ancient theory of evolution.

In the beginning of the eighteenth century, De Maillet made the first serious attempt to apply the doctrine to the living world. In the latter part of it, Erasmus Darwin, Goethe, Treviranus, and Lamarck took up the work more vigorously and with better qualifications. The question of special creation, or evolution, lay at the bottom of the fierce disputes which broke out in the French Academy between Cuvier and St. Hilaire; and, for a time, the supporters of biological evolution were silenced, if not answered, by the alliance of the greatest naturalist of the age with their ecclesiastical opponents. Catastrophism, a short-sighted teleology, and a still more short-sighted orthodoxy, joined forces to crush evolution.

Lyell and Poulett Scrope, in this country, resumed the work of the Italians and of Hutton; and the [99] former, aided by a marvellous power of clear exposition, placed upon an irrefragable basis the truth that natural causes are competent to account for all events, which can be proved to have occurred, in the course of the secular changes which have taken place during the deposition of the stratified rocks. The publication of "The Principles of Geology," in 1830, constituted an epoch in geological science. But it also constituted an epoch in the modern history of the doctrine of evolution, by raising in the mind of every intelligent reader this question: If natural causation is competent to account for the not-living part of our globe, why should it not account for the living part?

By keeping this question before the public for some thirty years, Lyell, though the keenest and most formidable of the opponents of the transmutation theory, as it was formulated by Lamarck, was of the greatest possible service in facilitating the reception of the sounder doctrines of a later day. And, in like fashion, another vehement opponent of the transmutation of species, the elder Agassiz, was doomed to help the cause he hated. Agassiz not only maintained the fact of the progressive advance in organisation of the inhabitants of the earth at each successive geological epoch, but he insisted upon the analogy of the steps of this progression with those by which the embryo advances to the adult condition, among the highest forms of each group. In fact, in endeavouring to [100] support these views he went a good way beyond the limits of any cautious interpretation of the facts then known.

Although little acquainted with biological science, Whewell seems to have taken particular pains with that part of his work which deals with the history of geological and biological speculation; and several chapters of his seventeenth and eighteenth books, which comprise the history of physiology, of comparative anatomy and of the palætiological sciences, vividly reproduce the controversies of the early clays of the Victorian epoch. But here, as in the case of the doctrine of the conservation of energy, the historian of the inductive sciences has no prophetic insight; not even a suspicion of that which the near future was to bring forth. And those who still repeat the once favourite objection that Darwin's "Origin of Species" is nothing but a new version of the "Philosophie zoologique" will find that, so late as 1844, Whewell had not the slightest suspicion of Darwin's main theorem, even as a logical possibility. In fact, the publication of that theorem by Darwin and Wallace, in 1859, took all the biological world by surprise. Neither those who were inclined towards the "progressive transmutation" or "development" doctrine, as it was then called, nor those who were opposed to it, had the slightest suspicion that the tendency to variation in living beings, which all admitted as a matter of fact; the selective influence of con[101]ditions, which no one could deny to be a matter of fact, when his attention was drawn to the evidence; and the occurrence of great geological changes, which also was matter of fact; could be; used as the only necessary postulates of a theory of the evolution of plants and animals which, even if not, at once, competent to explain all the known facts of biological science, could not be shown to be inconsistent with any. So far as biology is concerned, the publication of the "Origin of Species," for the first time, put the doctrine of evolution, in its application to living things, upon a sound scientific foundation. It became an instrument of investigation, and in no hands did it prove more brilliantly profitable than in those of Darwin himself. His publications on the effects of domestication in plants and animals, on the influence of cross-fertilisation, on flowers as organs for effecting such fertilisation, on insectivorous plants, on the motions of plants, pointed out the routes of exploration which have since been followed by hosts of inquirers, to the great profit of science.

Darwin found the biological world a more than sufficient field for even his great powers, and left the cosmical part of the doctrine to others. Not much has been added to the nebular hypothesis, since the time of Laplace, except that the attempt to show (against that hypothesis) that all nebulæ are star clusters, has been met by the spectroscopic [102] proof of the gaseous condition of some of them. Moreover, physicists of the present generation appear now to accept the secular cooling of the earth, which is one of the corollaries of that hypothesis. In fact, attempts have been made, by the help of deductions from the data of physics, to lay down an approximate limit to the number of millions of years which have elapsed since the earth was habitable by living beings. If the conclusions thus reached should stand the test of further investigation, they will undoubtedly be very valuable. But, whether true or false, they can have no influence upon the doctrine of evolution in its application to living organisms. The occurrence of successive forms of life upon our globe is an historical fact, which cannot be disputed; and the relation of these successive forms, as stages of evolution of the same type, is established in various cases. The biologist has no means of determining the time over which the process of evolution has extended, but accepts the computation of the physical geologist and the physicist, whatever that may be.

Evolution, as a philosophical doctrine applicable to all phenomena, whether physical or mental, whether manifested by material atoms or by men in society, has been dealt with systematically in the "Synthetic

Philosophy" of Mr. Herbert Spencer. Comment on that great undertaking would not be in place here. I mention it because, [103] so far as I know, it is the first attempt to deal, on scientific principles, with modern scientific facts and speculations. For the "Philosophie positive" of M. Comte, with which Mr. Spencer's system of philosophy is sometimes compared, though it professes a similar object, is unfortunately permeated by a thoroughly unscientific spirit, and its author had no adequate acquaintance with the physical sciences even of his own time.

The doctrine of evolution, so far as the present physical cosmos is concerned, postulates the fixity of the rules of operation of the causes of motion in the material universe. If all kinds of matter are modifications of one kind, and if all modes of motion are derived from the same energy, the orderly evolution of physical nature out of one substratum and one energy implies that the rules of action of that energy should be fixed and definite. In the past history of the universe, back to that point, there can be no room for chance or disorder. But it is possible to raise the question whether this universe of simplest matter and definitely operating energy, which forms our hypothetical starting point, may not itself be a product of evolution from a universe of such matter, in which the manifestations of energy were not definite–in which, for example, our laws of motion held good for some units and not for others, or for the same units at one time [104] and not at another–and which would therefore be a real epicurean chance-world?

For myself, I must confess that I find the air of this region of speculation too rarefied for my constitution, and I am disposed to take refuge in "ignoramus et ignorabimus."

The execution of my further task, the indication of the most important achievements in the several branches of physical science during the last fifty years, is embarrassed by the abundance of the objects of choice; and by the difficulty which every one, but a specialist in each department, must find in drawing a due distinction between discoveries which strike the imagination by their novelty, or by their practical influence, and those unobtrusive but pregnant observations and experiments in which the germs of the great things of the future really lie. Moreover, my limits restrict me to little more than a bare chronicle of the events which I have to notice.

In physics and chemistry, the old boundaries of which sciences are rapidly becoming effaced, one can hardly go wrong in ascribing a primary value to the investigations into the relation between the solid, liquid, and gaseous states of matter on the one hand, and degrees of pressure and of heat on the other. Almost all, even the most refractory, solids have been vapourised by the intense heat of the electric arc; and the most refractory gases [105] have been forced to assume the liquid, and even the solid, forms by the combination of high pressure with intense cold. It has further been shown that there is no discontinuity between these states–that a gas passes into the liquid state through a condition which is neither one nor the other, and that a liquid body becomes solid, or a solid liquid, by the intermediation of a condition in which it is neither truly solid nor truly liquid.

Theoretical and experimental investigations have concurred in the establishment of the view that a gas is a body, the particles of which are in incessant rectilinear motion at high velocities, colliding with one

another and bounding back when they strike the walls of the containing vessel; and, on this theory, the already ascertained relations of gaseous bodies to heat and pressure have been shown to be deducible from mechanical principles. Immense improvements have been effected in the means of exhausting a given space of its gaseous contents; and experimentation on the phenomena which attend the electric discharge and the action of radiant heat, within the extremely rarefied media thus produced, has yielded a great number of remarkable results, some of which have been made familiar to the public by the Gieseler tubes and the radiometer. Already, these investigations have afforded an unexpected insight into the constitution of matter and its relations with thermal and [106] electric energy, and they open up a vast field for future inquiry into some of the deepest problems of physics. Other important steps, in the same direction, have been effected by investigations into the absorption of radiant heat proceeding from different sources by solid, fluid, and gaseous bodies. And it is a curious example of the interconnection of the various branches of physical science, that some of the results thus obtained have proved of great importance in meteorology.

The existence of numerous dark lines, constant in their number and position in the various regions of the solar spectrum, was made out by Fraunhofer in the early part of the present century, but more than forty years elapsed before their causes were ascertained and their importance recognised. Spectroscopy, which then took its rise, is probably that employment of physical knowledge, already won, as a means of further acquisition, which most impresses the imagination. For it has suddenly and immensely enlarged our power of overcoming the obstacles which almost infinite minuteness on the one hand, and almost infinite distance on the other, have hitherto opposed to the recognition of the presence and the condition of matter. One eighteen-millionth of a grain of sodium in the flame of a spirit-lamp may be detected by this instrument; and, at the same time, it gives trustworthy indications of the material constitution not only of the sun, but of the farthest of those fixed stars [107] and nebulæ which afford sufficient light to affect the eye, or the photographic plate, of the inquirer.

The mathematical and experimental elucidation of the phenomena of electricity, and the study of the relations of this form of energy with chemical and thermal action, had made extensive progress before 1837. But the determination of the influence of magnetism on light, the discovery of diamagnetism, of the influence of crystalline structure on magnetism, and the completion of the mathematical theory of electricity, all belong to the present epoch. To it also appertain the practical execution and the working out of the results of the great international system of observations on terrestrial magnetism, suggested by Humboldt in 1836; and the invention of instruments of infinite delicacy and precision for the quantitative determination of electrical phenomena. The voltaic battery has received vast improvements; while the invention of magneto-electric engines and of improved means of producing ordinary electricity has provided sources of electrical energy vastly superior to any before extant in power, and far more convenient for use.

It is perhaps this branch of physical science which may claim the palm for its practical fruits, no less than for the aid which it has furnished to the investigation of other parts of the field of physical science. The idea of the practicability of establishing a communication between distant [108] points, by means of electricity, could hardly fail to have simmered in the minds of ingenious men since, well-nigh a century ago, experimental proof was given that electric disturbances could be propagated through a wire twelve

thousand feet long. Various methods of carrying the suggestion into practice had been carried out with some degree of success; but the system of electric telegraphy, which, at the present time, brings all parts of the civilised world within a few minutes of one another, originated only about the commencement of the epoch under consideration. In its influence on the course of human affairs, this invention takes its place beside that of gunpowder, which tended to abolish the physical inequalities of fighting men; of printing, which tended to destroy the effect of inequalities in wealth among learning men; of steam transport, which has done the like for travelling men. All these gifts of science are aids in the process of levelling up; of removing the ignorant and baneful prejudices of nation against nation, province against province, and class against class; of assuring that social order which is the foundation of progress, which has redeemed Europe from barbarism, and against which one is glad to think that those who, in our time, are employing themselves in fanning the embers of ancient wrong, in setting class against class, and in trying to tear asunder the existing bonds of unity, are undertaking a futile struggle. The telephone is only [109] second in practical importance to the electric telegraph. Invented, as it were, only the other day, it has already taken its place as an appliance of daily life. Sixty years ago, the extraction of metals from their solutions, by the electric current, was simply a highly interesting scientific fact. At the present day, the galvano-plastic art is a great industry; and, in combination with photography, promises to be of endless service in the arts. Electric lighting is another great gift of science to civilisation, the practical effects of which have not yet been fully developed, largely on account of its cost. But those whose memories go back to the tinder-box period, and recollect the cost of the first lucifer matches, will not despair of the results of the application of science and ingenuity to the cheap production of anything for which there is a large demand.

The influence of the progress of electrical knowledge and invention upon that of investigation in other fields of science is highly remarkable. The combination of electrical with mechanical contrivances has produced instruments by which, not only may extremely small intervals of time be exactly measured, but the varying rapidity of movements, which take place in such intervals and appear to the ordinary sense instantaneous, is recorded. The duration of the winking of an eye is a proverbial expression for an instantaneous action; but, by the help of the revolving cylinder [110] and the electrical marking-apparatus, it is possible to obtain a graphic record of such an action, in which, if it endures a second, that second shall be subdivided into a hundred, or a thousand, equal parts, and the state of the action at each hundredth, or thousandth, of a second exhibited. In fact, these instruments may be said to be time-microscopes. Such appliances have not only effected a revolution in physiology, by the power of analysing the phenomena of muscular and nervous activity which they have conferred, but they have furnished new methods of measuring the rate of movement of projectiles to the artillerist. Again, the microphone, which renders the minutest movements audible, and which enables a listener to hear the footfall of a fly, has equipped the sense of hearing with the means of entering almost as deeply into the penetralia of Nature, as does the sense of sight.

That light exerts a remarkable influence in bringing about certain chemical combinations and decompositions was well known fifty years ago, and various more or less successful attempts to produce permanent pictures, by the help of that knowledge, had already been made. It was not till 1839, however, that practical success was obtained; but the "daguerreotypes" were both cumbrous and costly, and photography would never have attained its present important development had not the progress of

invention substituted [111] paper and glass for the silvered plates then in use. It is not my affair to dwell upon the practical application of the photography of the present day, but it is germane to my purpose to remark that it has furnished a most valuable accessory to the methods of recording motions and lapse of time already in existence. In the hands of the astronomer and the meteorologist, it has yielded means of registering terrestrial, solar, planetary, and stellar phenomena, independent of the sources of error attendant on ordinary observation; in the hands of the physicist, not only does it record spectroscopic phenomena with unsurpassable ease and precision, but it has revealed the existence of rays having powerful chemical energy, or beyond the visible limits of either end of the spectrum; while, to the naturalist, it furnishes the means by which the forms of many highly complicated objects may be represented, without that possibility of error which is inherent in the work of the draughtsman. In fact, in many cases, the stern impartiality of photography is an objection to its employment: it makes no distinction between the important and the unimportant; and hence photographs of dissections, for example, are rarely so useful as the work of a draughtsman who is at once accurate and intelligent.

The determination of the existence of a new planet, Neptune, far beyond the previously known bounds of the solar system, by mathematical [112] deduction from the facts of perturbation; and the immediate confirmation of that determination, in the year 1846, by observers who turned their telescopes into the part of the heavens indicated as its place, constitute a remarkable testimony of nature to the validity of the principles of the astronomy of our time. In addition, so many new asteroids have been added to those which were already known to circulate in the place which theoretically should be occupied by a planet, between Mars and Jupiter, that their number now amounts to between two and three hundred. I have already alluded to the extension of our knowledge of the nature of the heavenly bodies by the employment of spectroscopy. It has not only thrown wonderful light upon the physical and chemical constitution of the sun, fixed stars, and nebulæ, and comets, but it holds out a prospect of obtaining definite evidence as to the nature of our so-called elementary bodies.

The application of the generalisations of thermotics to the problem of the duration of the earth, and of deductions from tidal phenomena to the determination of the length of the day and of the time of revolution of the moon, in past epochs of the history of the universe; and the demonstration of the competency of the great secular changes, known under the general name of the precession of the equinoxes, to cause corresponding modifications in the climate of the two hemi[113]spheres of our globe, have brought astronomy into intimate relation with geology. Geology, in fact, proves that, in the course of the past history of the earth, the climatic conditions of the same region have been widely different, and seeks the explanation of this important truth from the sister sciences. The facts that, in the middle of the Tertiary epoch, evergreen trees abounded within the arctic circle; and that, in the long subsequent Quaternary epoch, an arctic climate, with its accompaniment of gigantic glaciers, obtained in the northern hemisphere, as far south as Switzerland and Central France, are as well established as any truths of science. But, whether the explanation of these extreme variations in the mean temperature of a great part of the northern hemisphere is to be sought in the concomitant changes in the distribution of land and water surfaces of which geology affords evidence, or in astronomical conditions, such as those to which I have referred, is a question which must await its answer from the science of the future.

Turning now to the great steps in that vast progress which the biological sciences have made since 1837,

we are met, on the threshold of our epoch, with perhaps the greatest of all–namely, the promulgation by Schwann, in 1839, of the generalisation known as the "cell theory," the application and extension of which by a host of subsequent investigators has revolutionised [114] morphology, development, and physiology. Thanks to the immense series of labours thus inaugurated, the following fundamental truths have been established.

All living bodies contain substances of closely similar physical and chemical composition, which constitute the physical basis of life, known as protoplasm. So far as our present knowledge goes, this takes its origin only from pre-existing protoplasm.

All complex living bodies consist, at one period of their existence, of an aggregate of minute portions of such substance, of similar structure, called cells, each cell having its own life independent of the others, though influenced by them.

All the morphological characters of animals and plants are the results of the mode of multiplication, growth, and structural metamorphosis of these cells, considered as morphological units.

All the physiological activities of animals and plants–assimilation, secretion, excretion, motion, generation–are the expression of the activities of the cells considered as physiological units. Each individual, among the higher animals and plants, is a synthesis of millions of subordinate individualities. Its individuality, therefore, is that of a "civitas" in the ancient sense, or that of the Leviathan of Hobbes.

There is no absolute line of demarcation between [115] animals and plants. The intimate structure, and the modes of change, in the cells of the two are fundamentally the same. Moreover, the higher forms are evolved from lower, in the course of their development, by analogous processes of differentiation, coalescence, and reduction in both the vegetable and the animal worlds.

At the present time, the cell theory, in consequence of recent investigations into the structure and metamorphosis of the "nucleus" is undergoing a new development of great significance, which among other things, foreshadows the possibility of the establishment of a physical theory of heredity, on a safer foundation than those which Buffon and Darwin have devised.

The popular belief in abiogenesis, or the so-called "spontaneous" generation of the lower forms of life, which was accepted by all the philosophers of antiquity, held its ground down to the middle of the seventeenth century. Notwithstanding the frequent citation of the phrase, wrongfully attributed to Harvey, "Omne vivum ex ovo," that great physiologist believed in spontaneous generation as firmly as Aristotle did. And it was only in the latter part of the seventeenth century, that Redi, by simple and well-devised experiments, demonstrated that, in a great number of cases of supposed spontaneous generation, the animals which made their appearance owed their origin to [116] the ordinary process of reproduction, and thus shook the ancient doctrine to its foundations. In the middle of the eighteenth century, it was revived, in a new form, by Needham and Buffon; but the experiments of Spallanzani enforced the conclusions of Redi, and compelled the advocates of the occurrence of spontaneous

generation to seek evidence for their hypothesis only among the parasites and the lowest and minutest organisms. It is just fifty years since Schwann and others proved that, even with respect to them, the supposed evidence of abiogenesis was untrustworthy.

During the present epoch, the question, whether living matter can be produced in any other way than by the physiological activity of other living matter, has been discussed afresh with great vigour; and the problem has been investigated by experimental methods of a precision and refinement unknown to previous investigators. The result is that the evidence in favour of abiogenesis has utterly broken down, in every case which has been properly tested. So far as the lowest and minutest organisms are concerned, it has been proved that they never make their appearance, if those precautions by which their germs are certainly excluded are taken. And, in regard to parasites, every case which seemed to make for their generation from the substance of the animal, or plant, which they infest has been proved to [117] have a totally different significance. Whether not-living matter may pass, or ever has, under any conditions, passed into living matter, without the agency of pre-existing living matter, necessarily remains an open question; all that can be said is that it does not undergo this metamorphosis under any known conditions. Those who take a monistic view of the physical world may fairly hold abiogenesis as a pious opinion, supported by analogy and defended by our ignorance. But, as matters stand, it is equally justifiable to regard the physical world as a sort of dual monarchy. The kingdoms of living matter and of not-living matter are under one system of laws, and there is a perfect freedom of exchange and transit from one to the other. But no claim to biological nationality is valid except birth.

In the department of anatomy and development, a host of accurate and patient inquirers, aided by novel methods of preparation, which enable the anatomist to exhaust the details of visible structure and to reproduce them with geometrical precision, have investigated every important group of living animals and plants, no less than the fossil relics of former faunæ and floræ. An enormous addition has thus been made to our knowledge, especially of the lower forms of life, and it may be said that morphology, however inexhaustible in detail, is complete in its broad features. Classification, which is merely a convenient summary expres[118]sion of morphological facts, has undergone a corresponding improvement. The breaks which formerly separated our groups from one another, as animals from plants, vertebrates from invertebrates, cryptogams from phanerogams, have either been filled up, or shown to have no theoretical significance. The question of the position of man, as an animal, has given rise to much disputation, with the result of proving that there is no anatomical or developmental character by which he is more widely distinguished from the group of animals most nearly allied to him, than they are from one another. In fact, in this particular, the classification of Linnæus has been proved to be more in accordance with the facts than those of most of his successors.

The study of man, as a genus and species of the animal world, conducted with reference to no other considerations than those which would be admitted by the investigator of any other form of animal life, has given rise to a special branch of biology, known as Anthropology, which has grown with great rapidity. Numerous societies devoted to this portion of science have sprung up, and the energy of its devotees has produced a copious literature. The physical characters of the various races of men have been studied with a minuteness and accuracy heretofore unknown; and demonstrative evidence of the existence of human contemporaries of the extinct animals of the latest [119] geological epoch has been

obtained. Physical science has thus been brought into the closest relation with history and with archæology; and the striking investigations which, during our time, have put beyond doubt the vast antiquity of Babylonian and Egyptian civilisation, are in perfect harmony with the conclusions of anthropology as to the antiquity of the human species.

Classification is a logical process which consists in putting together those things which are like and keeping asunder those which are unlike; and a morphological classification, of course, takes note only of morphological likeness and unlikeness. So long, therefore, as our morphological knowledge was almost wholly confined to anatomy, the characters of groups were solely anatomical; but as the phenomena of embryology were explored, the likeness and unlikeness of individual development had to be taken into account; and, at present, the study of ancestral evolution introduces a new element of likeness and unlikeness which is not only eminently deserving of recognition, but must ultimately predominate over all others. A classification which shall represent the process of ancestral evolution is, in fact, the end which the labours of the philosophical taxonomist must keep in view. But it is an end which cannot be attained until the progress of palæontology has given us far more insight, than we yet possess, into the historical facts of the case. Much of the [120] speculative "phylogeny," which abounds among my present contemporaries, reminds me very forcibly of the speculative morphology, unchecked by a knowledge of development, which was rife in my youth. As hypothesis, suggesting inquiry in this or that direction, it is often extremely useful; but, when the product of such speculation is placed on a level with those generalisations of morphological truths which are represented by the definitions of natural groups, it tends to confound fancy with fact and to create mere confusion. We are in danger of drifting into a new "Natur-Philosophie" worse than the old, because there is less excuse for it. Boyle did great service to science by his "Sceptical Chemist," and I am inclined to think that, at the present day, a "Sceptical Biologist" might exert an equally beneficent influence.

Whoso wishes to gain a clear conception of the progress of physiology, since 1837, will do well to compare Müller's "Physiology," which appeared in 1835, and Drapiez's edition of Riehard's "Nouveaux Elements de Botanique," published in 1837, with any of the present handbooks of animal and vegetable physiology. Müller's work was a masterpiece, unsurpassed since the time of Haller, and Riehard's book enjoyed a great reputation at the time; but their successors transport one into a new world. That which characterises the new physiology is that it is permeated by, and indeed based upon, conceptions which, though not wholly [121] absent, are but dawning on the minds of the older writers.

Modern physiology sets forth as its chief ends: Firstly, the ascertainment of the facts and conditions of cell-life in general. Secondly, in composite organisms, the analysis of the functions of organs into those of the cells of which they are composed. Thirdly, the explication of the processes by which this local cell-life is directly, or indirectly, controlled and brought into relation with the life of the rest of the cells which compose the organism. Fourthly, the investigation of the phenomena of life in general, on the assumption that the physical and chemical processes which take place in the living body are of the same order as those which take place out of it; and that whatever energy is exerted in producing such phenomena is derived from the common stock of energy in the universe. In the fifth place, modern physiology investigates the relation between physical and psychical phenomena, on the assumption that molecular changes in definite portions of nervous matter stand in the relation of necessary antecedents to

definite mental states and operations. The work which has been done in each of the directions here indicated is vast, and the accumulation of solid knowledge, which has been effected, is correspondingly great. For the first time in the history of science, physiologists are now in a position to say that they have arrived at [122] clear and distinct, though by no means compete, conceptions of the manner in which the great functions of assimilation, respiration, secretion, distribution of nutriment, removal of waste products, motion, sensation, and reproduction are performed; while the operation of the nervous system, as a regulative apparatus, which influences the origination and the transmission of manifestations of activity, either within itself or in other organs, has been largely elucidated.

I have pointed out, in an earlier part of this essay, that the history of all branches of science proves that they must attain a considerable stage of development before they yield practical "fruits;" and this is eminently true of physiology. It is only within the present epoch, that physiology and chemistry have reached the point at which they could offer a scientific foundation to agriculture; and it is only within the present epoch, that zoology and physiology have yielded any very great aid to pathology and hygiene. But, within that time, they have already rendered highly important services by the exploration of the phenomena of parasitism. Not only have the history of the animal parasites, such as the tapeworms and the trichina, which infest men and animals, with deadly results, been cleared up by means of experimental investigations, and efficient modes of prevention deduced from the data so obtained; In it the terrible agency of the para[123]sitic fungi and of the infinitesimally minute microbes, which work far greater havoc among plants and animals, has been brought to light. The "particulate" or "germ" theory of disease, as it is called, long since suggested, has obtained a firm foundation, in so far as it has been proved to be true in respect of sundry epidemic disorders. Moreover, it has theoretically justified prophylactic measures, such as vaccination, which formerly rested on a merely empirical basis; and it has been extended to other diseases with excellent results. Further, just as the discovery of the cause of scabies proved the absurdity of many of the old prescriptions for the prevention and treatment of that disease; so the discovery of the cause of splenic fever, and other such maladies, has given a new direction to prophylactic and curative measures against the worst scourges of humanity. Unless the fanaticism of philozoic sentiment overpowers the voice of philanthropy, and the love of dogs and cats supersedes that of one's neighbour, the progress of experimental physiology and pathology will, indubitably, in course of time, place medicine and hygiene upon a rational basis. Two centuries ago England was devastated by the plague; cleanliness and common sense were enough to free us from its ravages. One century since, small-pox was almost as great a scourge; science, though working empirically, and almost in the dark, has reduced that evil to relative in[124]significance. At the present time, science, working in the light of clear knowledge, has attacked splenic fever and has beaten it; it is attacking hydrophobia with no mean promise of success; sooner or later it will deal, in the same way, with diphtheria, typhoid and scarlet fever. To one who has seen half a street swept clear of its children, or has lost his own by these horrible pestilences, passing one's offspring through the fire to Moloch seems humanity, compared with the proposal to deprive them of half their chances of health and life because of the discomfort to dogs and cats, rabbits and frogs, which may be involved in the search for means of guarding them.

An immense extension has been effected in our knowledge of the distribution of plants and animals; and the elucidation of the causes which have brought about that distribution has been greatly advanced. The

establishment of meteorological observations by all civilised nations, has furnished a solid foundation to climatology; while a growing sense of the importance of the influence of the "struggle for existence" affords a wholesome check to the tendency to overrate the influence of climate on distribution. Expeditions, such as that of the "Challenger," equipped, not for geographical exploration and discovery, but for the purpose of throwing light on problems of physical and biological science, have been sent out by our own and other Govern[125]ments, and have obtained stores of information of the greatest value. For the first time, we are in possession of something like precise knowledge of the physical features of the deep seas, and of the living population of the floor of the ocean. The careful and exhaustive study of the phenomena presented by the accumulations of snow and ice, in polar and mountainous regions, which has taken place in our time, has not only revealed to the geologist an agent of denudation and transport, which has slowly and quietly produced effects, formerly confidently referred to diluvial catastrophes, but it has suggested new methods of accounting for various puzzling facts of distribution.

Palæontology, which treats of the extinct forms of life and their succession and distribution upon our globe, a branch of science which could hardly be said to exist a century ago, has undergone a wonderful development in our epoch. In some groups of animals and plants, the extinct representatives, already known, are more numerous and important than the living. There can be no doubt that the existing Fauna and Flora is but the last term of a long series of equally numerous contemporary species, which have succeeded one another, by the slow and gradual substitution of species for species, in the vast interval of time which has elapsed between the deposition of the earliest fossiliferous strata and the present day. [126] There is no reasonable ground for believing that the oldest remains yet obtained carry us even near the beginnings of life. The impressive warnings of Lyell against hasty speculations, based upon negative evidence, have been fully justified; time after time, highly organised types have been discovered in formations of an age in which the existence of such forms of life had been confidently declared to be impossible. The western territories of the United States alone have yielded a world of extinct animal forms, undreamed of fifty years ago. And, wherever sufficiently numerous series of the remains of any given group, which has endured for a long space of time, are carefully examined, their morphological relations are never in discordance with the requirements of the doctrine of evolution, and often afford convincing evidence of it. At the same time it has been shown that certain forms persist with very little change, from the oldest to the newest fossiliferous formations; and thus show that progressive development is a contingent, and not a necessary, result of the nature of living matter.

Geology is, as it were, the biology of our planet as a whole. In so far as it comprises the surface configuration and the inner structure of the earth, it answers to morphology; in so far as it studies changes of condition and their causes, it corresponds with physiology; in so far as it deals with the causes which have effected the progress of the [127] earth from its earliest to its present state, it forms part of the general doctrine of evolution. An interesting contrast between the geology of the present day and that of half a century ago, is presented by the complete emancipation of the modern geologist from the controlling and perverting influence of theology, all-powerful at the earlier date. As the geologist of my young days wrote, he had one eye upon fact, and the other on Genesis; at present, he wisely keeps both eyes on fact, and ignores the pentateuchal mythology altogether. The publication of the "Principles of Geology" brought upon its illustrious author a period of social ostracism; the instruction given to our children is based upon those principles. Whewell had the courage to attack Lyell's fundamental

assumption (which surely is a dictate of common sense) that we ought to exhaust known causes before seeking for the explanation of geological phenomena in causes of which we have no experience. But geology has advanced to its present state by working from Lyell's[10] axiom; and, to this day, the record of the stratified rocks affords no proof that the intensity or the rapidity of action of the causes of change has ever varied between wider limits than those between which [128] the operations of Nature have taken place in the youngest geological epochs.

An incalculable benefit has accrued to geological science from the accurate and detailed surveys, which have now been executed by skilled geologists employed by the Governments of all parts of the civilised world. In geology, the study of large maps is as important as it is said to be in politics; and sections, on a true scale, are even more important, in so far as they are essential to the apprehension of the extraordinary insignificance of geological perturbations in relation to the whole mass of our planet. It should never be forgotten that what we call "catastrophes," are, in relation to the earth, changes, the equivalents of which would be well represented by the development of a few pimples, or the scratch of a pin, on a man's head. Vast regions of the earth's surface remain geologically unknown; but the area already fairly explored is many times greater than it was in 1837; and, in many parts of Europe and the United States, the structure of the superficial crust of the earth has been investigated with great minuteness.

The parallel between Biology and Geology, which I have drawn, is further illustrated by the modern growth of that branch of the science known as Petrology, which answers to Histology, and has made the microscope as essential an instrument to the geological as to the biological investigator.

[129] The evidence of the importance of causes now in operation has been wonderfully enlarged by the study of glacial phænomena; by that of earthquakes and volcanoes; and by that of the efficacy of heat and cold, wind, rain, and rivers as agents of denudation and transport. On the other hand, the exploration of coral reefs and of the deposits now taking place at the bottom of the great oceans, has proved that, in animal and plant life, we have agents of reconstruction of a potency hitherto unsuspected.

There is no study better fitted than that of geology to impress upon men of general culture that conviction of the unbroken sequence of the order of natural phænomena, throughout the duration of the universe, which is the great, and perhaps the most important, effect of the increase of natural knowledge.

[I desire to express my obligations to Messrs. Smith, Elder and Co. for their courteous permission to reprint this essay from "The Reign of Queen Victoria."]

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[1] There are excellent examples to the same effect in Zeller's *Philosophie der Gricchen*, Theil II. Abth. ii. p. 407, and in Eucken's *Die Methode der Aristotelischen Forschung*, pp. 138 *et seq.*

[2] Fresnel, after a brilliant career of discovery in some of the most difficult regions of physico-mathematical

science, died at thirty-nine years of age. The following passage of a letter from him to Young (written in November, 1824), quoted by Whewell so aptly illustrates the spirit which animates the scientific inquirer that I may cite it:

"For a long time that sensibility, or that vanity, which people call love of glory is much blunted in me. I labour much less to catch the suffrages of the public than to obtain an inward approval which has always been the mental reward of my efforts. Without doubt I have often wanted the spur of vanity to excite me to pursue my researches in moments of disgust and discouragement. But all the compliments which I have received from MM. Arago, De Laplace, or Biot, never gave me so much pleasure as the discovery of a theoretical truth or the confirmation of a calculation by experiment."

[3] "Mémorable exemple de l'impuissance des recherches collectives appliquées à la découverte des vérités nouvelles!" says one of the most distinguished of living French *savants,* of the corporate chemical work of the old Académie des Sciences. (See Berthelot, *Science et Philosophie,* p. 201.)

[4] I am particularly indebted to my friend and colleague, Professor Rücker, F.R.S., for the many acute criticisms and suggestions on my remarks respecting the ultimate problems of physics, with which he has favoured me, and by which I have greatly profited.

[5] I am aware that this proposition may be challenged. It may be said, for example, that, on the hypothesis of Boscovich, matter has no extension, being reduced to mathematical points serving as centres of "forces." But as the "forces" of the various centres are conceived to limit one another's action in such a manner that an area around each centre has an individuality of its own, extension comes back in the form of that area. Again, a very eminent mathematician and physicist–the late Clerk Maxwell–has declared that impenetrability is not essential to our notions of matter, and that two atoms may conceivably occupy the same space. I am loth to dispute any dictum of a philosopher as remarkable for the subtlety of his intellect as for his vast knowledge; but the assertion that one and the same point or area of space can have different (conceivably opposite) attributes appears to me to violate the principle of contradiction, which is the foundation not only of physical science, but of logic in general. It means that A can be not-A.

[6] "Molecule" would be the more appropriate name for such a particle. Unfortunately, chemists employ this term in a special sense, as a name for an aggregation of their smallest particles, for which they retain the designation of "atoms."

[7] "At present, more organic analyses are made in a single day than were accomplished before Liebig's time in a whole year."–Hofmann, *Faraday Lecture,* p. 46.

[8] In the preface to his *Mécanique Chimique,* M. Berthelot declares his object to be "ramener la chimie tout entière . . . aux memes principes mécaniques qui régissent déjà les diverses branches de la physique."

[9] This is the more curious, as Ampere's hypothesis that vibrations of molecules, causing and caused by vibrations of the ether, constitute heat, is discussed. See vol. ii. p. 587, 2nd ed. In the *Philosophy of the Inductive Sciences,* 2nd ed. 1847, p. 239, Whewell remarks, *a propos* of Bacon's definition of heat, "that it is an expansive, restrained motion, modified in certain ways, and exerted in the smaller particles of the body;" that "although the exact

nature of heat is still an obscure and controverted matter, the science of heat now consists of many important truths; and that to none of these truths is there any approximation in Bacon's essay." In point of fact, Bacon's statement, however much open to criticism, does contain a distinct approximation to the most important of all the truths respecting heat which had been discovered when Whewell wrote.

[10] Perhaps I ought rather to say Buffon's axiom. For that great naturalist and writer embodied the principles of sound Geology in a pithy phrase of the *Théorie de la Terre:* "Pour juger de ce qui est arrivé, et même de ce qui arrivera, nous n'avous qu'à examiner ce qui arrive."

THE HUXLEY FILE

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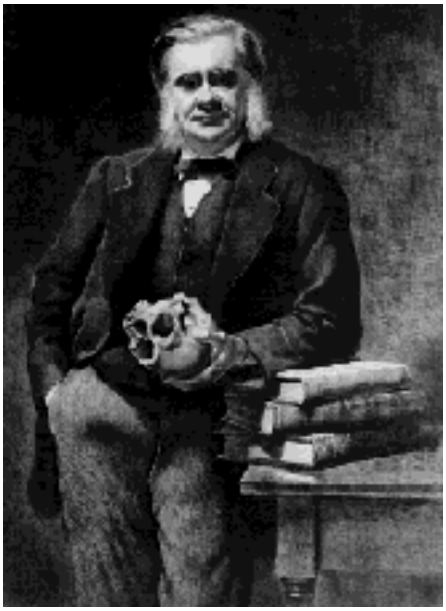

"Inventor of Protoplasm"

"A great Med'cine Man, among the Inqui-ring Redskins"

Vanity Fair January 28, 1871

Professor Huxley, the inventor of Protoplasm ... **Men of the Day** *Vanity Fair*, January 28, 1871

On the Physical Basis of Life[1] (1868)

Collected Essays I

[130] In order to make the title of this discourse generally intelligible, I have translated the term "Protoplasm," which is the scientific name of the substance of which I am about to speak, by the words "the physical basis of life." I suppose that, to many, the idea that there is such a thing as a physical basis, or matter, of life may be novel–[131] so widely spread is the conception of life as a something which works through matter, but is independent of it; and even those who are aware that matter and life are inseparably connected, may not be prepared for the conclusion plainly suggested by the phrase, "*the* physical basis or matter of life," that there is some one kind of matter which is common to all living beings, and that their endless diversities are bound together by a physical, as well as an ideal, unity. In fact, when first apprehended, such a doctrine as this appears almost shocking to common sense.

What, truly, can seem to be more obviously different from one another, in faculty, in form, and in substance, than the various kinds of living beings? What community of faculty can there be between the bright-coloured lichen, which so nearly resembles a mere mineral incrustation of the bare rock on which it grows, and the painter, to whom it is instinct with beauty, or the botanist, whom it feeds with knowledge?

Again, think of the microscopic fungus–a mere infinitesimal ovoid particle, which finds space and duration enough to multiply into countless millions in the body of a living fly; and then of the wealth of foliage, the luxuriance of flower and fruit, which lies between this bald sketch of a plant and the giant pine of California, towering to the dimensions of a cathedral spire, or the Indian fig, which covers acres with its profound shadow, and [132] endures while nations and empires come and go around its vast circumference. Or, turning to the other half of the world of life, picture to yourselves the great Finner whale, hugest of beasts that live, or have lived, disporting his eighty or ninety feet of bone, muscle and blubber, with easy roll, among waves in which the stoutest ship that ever left dockyard would flounder hopelessly, and contrast him with the invisible animalcules–mere gelatinous specks, multitudes of which could, in fact, dance upon the point of a needle with the same ease as the angels of the Schoolmen could, in imagination. With these images before your minds, you may well ask, what community of form, or structure, is there between the animalcule and the whale; or between the fungus and the fig-tree? And, *a fortiori*, between all four?

Finally, if we regard substance, or material composition, what hidden bond can connect the flower

which a girl wears in her hair and the blood which courses through her youthful veins; or, what is there in common between the dense and resisting mass of the oak, or the strong fabric of the tortoise, and those broad disks of glassy jelly which may be seen pulsating through the waters of a calm sea, but which drain away to mere films in the hand which raises them out of their elements?

Such objections as these must, I think, arise in the mind of every one who ponders, for the first [133] time, upon the conception of a single physical basis of life underlying all the diversities of vital existence; but I propose to demonstrate to you that, notwithstanding these apparent difficulties, a threefold unity–namely, a unity of power or faculty, a unity of form, and a unity of substantial composition–does pervade the whole living world.

No very abstruse argumentation is needed, in the first place to prove that the powers, or faculties, of all kinds of living matter, diverse as they may be in degree, are substantially similar in kind.

Goethe has condensed a survey of all powers of mankind into the well-known epigram:–

"Warum treibt sich das Volk so und schreit? Es will sich ernähren
Kinder zeugen, und die nähren so gut es vermag.
* * * *
Weiter bringt es kein Mensch, stell' er sich wie er auch will."

In physiological language this means, that all the multifarious and complicated activities of man are comprehensible under three categories. Either they are immediately directed towards the maintenance and development of the body, or they effect transitory changes in the relative positions of parts of the body, or they tend towards the continuance of the species. Even those manifestations of intellect, of feeling, and of will, which [134] we rightly name the higher faculties, are not excluded from this classification, inasmuch as to every one but the subject of them, they are known only as transitory changes in the relative positions of parts of the body. Speech, gesture, and every other form of human action are, in the long run, resolvable into muscular contraction, and muscular contraction is but a transitory change in the relative positions of the parts of a muscle. But the scheme which is large enough to embrace the activities of the highest form of life, covers all those of the lower creatures. The lowest plant, or animalcule, feeds, grows, and reproduces its kind. In addition, all mammals manifest those transitory changes of form which we class under irritability and contractility; and, it is more than probable, that when the vegetable world is thoroughly explored, we shall find all plants in possession of the same powers, at one time or other of their existence.

I am not now alluding to such phænomena, at once rare and conspicuous, as those exhibited by the leaflets of the sensitive plants, or the stamens of the barberry, but to much more widely spread, and at the same time, more subtle and hidden, manifestations of vegetable contractility. You are doubtless aware that the common nettle owes its stinging property to the innumerable stiff and needle-like, though exquisitely delicate, hairs which cover its surface. Each stinging-needle tapers from a broad [135] base to a slender summit, which, though rounded at the end, is of such microscopic fineness that it readily penetrates, and breaks off in, the skin. The whole hair consists of a very delicate outer case of wood,

closely applied to the inner surface of which is a layer of semi-fluid matter, full of innumerable granules of extreme minuteness. This semi-fluid lining is protoplasm, which thus constitutes a kind of bag, full of a limpid liquid, and roughly corresponding in form with the interior of the hair which it fills. When viewed with a sufficiently high magnifying power, the protoplasmic layer of the nettle hair is seen to be in a condition of unceasing activity. Local contractions of the whole thickness of its substance pass slowly and gradually from point to point, and give rise to the appearance of progressive waves, just as the bending of successive stalks of corn by a breeze produces the apparent billows of a cornfield.

But, in addition to these movements, and independently of them, the granules are driven, in relatively rapid streams, through channels in the protoplasm which seem to have a considerable amount of persistence. Most commonly, the currents in adjacent parts of the protoplasm take similar directions; and, thus, there is a general stream up one side of the hair and down the other. But this does not prevent the existence of partial currents which take different routes; and some[136]times trains of granules may be seen coursing swiftly in opposite directions within a twenty-thousandth of an inch of one another; while, occasionally, opposite streams come into direct collision, and, after a longer or shorter struggle, one predominates. The cause of these currents seems to lie in contractions of the protoplasm which bounds the channels in which they flow, but which are so minute that the best microscopes show only their effects, and not themselves.

The spectacle afforded by the wonderful energies prisoned within the compass of the microscopic hair of a plant, which we commonly regard as a merely passive organism, is not easily forgotten by one who has watched its display, continued hour after hour, without pause or sign of weakening. The possible complexity of many other organic forms, seemingly as simple as the protoplasm of the nettle, dawns upon one; and the comparison of such a protoplasm to a body with an internal circulation, which has been put forward by an eminent physiologist, loses much of its startling character. Currents similar to those of the hairs of the nettle have been observed in a great multitude of very different plants, and weighty authorities have suggested that they probably occur, in more or less perfection, in all young vegetable cells. If such be the case, the wonderful noonday silence of a tropical forest is, after all, due only to the dulness of our hearing; and could our ears [137] catch the murmur of these tiny Maelstroms, as they whirl in the innumerable myriads of living cells which constitute each tree, we should be stunned, as with the roar of a great city.

Among the lower plants, it is the rule rather than the exception, that contractility should be still more openly manifested at some periods of their existence. The protoplasm of *Algæ* and *Fungi* becomes, under many circumstances, partially, or completely, freed from its woody case, and exhibits movements of its whole mass, or is propelled by the contractility of one, or more, hair-like prolongations of its body, which are called vibratile cilia. And, so far as the conditions of the manifestation of the phænomena of contractility have yet been studied, they are the same for the plant as for the animal. Heat and electric shocks influence both, and in the same way, though it may be in different degrees. It is by no means my intention to suggest that there is no difference in faculty between the lowest plant and the highest, or between plants and animals. But the difference between the powers of the lowest plant, or animal, and those of the highest, is one of degree, not of kind, and depends, as Milne-Edwards long ago so well pointed out, upon the extent to which the principle of the division of labour is carried out in the living

economy. In the lowest organism all parts are competent to perform all functions, and one and the same portion of protoplasm may [138] successfully take on the function of feeding, moving, or reproducing apparatus. In the highest, on the contrary, a great number of parts combine to perform each function, each part doing its allotted share of the work with great accuracy and efficiency, but being useless for any other purpose.

On the other hand, notwithstanding all the fundamental resemblances which exist between the powers of the protoplasm in plants and in animals, they present a striking difference (to which I shall advert more at length presently), in the fact that plants can manufacture fresh protoplasm out of mineral compounds, whereas animals are obliged to procure it ready made, and hence, in the long run, depend upon plants. Upon what condition this difference in the powers of the two great divisions of the world of life depends, nothing is at present known.

With such qualifications as arise out of the last-mentioned fact, it may be truly said that the acts of all living things are fundamentally one. Is any such unity predicable of their forms? Let us seek in easily verified facts for a reply to this question. If a drop of blood be drawn by pricking one's finger, and viewed with proper precautions, and under a sufficiently high microscopic power, there will be seen, among the innumerable multitude of little, circular, discoidal bodies, or corpuscles, which float in it and give it its colour, a [139] comparatively small number of colourless corpuscles, of somewhat larger size and very irregular shape. If the drop of blood be kept at the temperature of the body, these colourless corpuscles will be seen to exhibit a marvellous activity, changing their forms with great rapidity, drawing in and thrusting out prolongations of their substance, and creeping about as if they were independent organisms.

The substance which is thus active is a mass of protoplasm, and its activity differs in detail, rather than in principle, from that of the protoplasm of the nettle. Under sundry circumstances the corpuscle dies and becomes distended into a round mass, in the midst of which is seen a smaller spherical body, which existed, but was more or less hidden, in the living corpuscle, and is called a *nucleus.* Corpuscles of essentially similar structure are to be found in the skin, in the lining of the mouth, and scattered through the whole framework of the body. Nay, more; in the earliest condition of the human organism, in that state in which it has but just become distinguishable from the egg in which it arises, it is nothing but an aggregation of such corpuscles, and every organ of the body was, once, no more than such an aggregation.

Thus a nucleated mass of protoplasm turns out to be what may be termed the structural unit of the human body. As a matter of fact, the body, [140] in its earliest state, is a mere multiple of such units; and in its perfect condition, it is a multiple of such units, variously modified.

But does the formula which expresses the essential structural character of the highest animal cover all the rest, as the statement of its powers and faculties covered that of all others? Very nearly. Beast and fowl, reptile and fish, mollusk, worm, and polype, are all composed of structural units of the same character, namely, masses of protoplasm with a nucleus. There are sundry very low animals, each of

which, structurally, is a mere colourless blood-corpuscle, leading an independent life. But, at the very bottom of the animal scale, even this simplicity becomes simplified, and all the phænomena of life are manifested by a particle of protoplasm without a nucleus. Nor are such organisms insignificant by reason of their want of complexity. It is a fair question whether the protoplasm of those simplest forms of life, which people an immense extent of the bottom of the sea, would not outweigh that of all the higher living beings which inhabit the land put together. And in ancient times, no less than at the present day, such living beings as these have been the greatest of rock builders.

What has been said of the animal world is no less true of plants. Imbedded in the protoplasm at the broad, or attached, end of the nettle hair, there lies a spheroidal nucleus. Careful examina[141]tion further proves that the whole substance of the nettle is made up of a repetition of such masses of nucleated protoplasm, each contained in a wooden case, which is modified in form, sometimes into a woody fibre, sometimes into a duct or spiral vessel, sometimes into a pollen grain, or an ovule. Traced back to its earliest state, the nettle arises as the man does, in a particle of nucleated protoplasm. And in the lowest plants, as in the lowest animals, a single mass of such protoplasm may constitute the whole plant, or the protoplasm may exist without a nucleus.

Under these circumstances it may well be asked, how is one mass of non-nucleated protoplasm to be distinguished from another? why call one "plant" and the other "animal"?

The only reply is that, so far as form is concerned, plants and animals are not separable, and that, in many cases, it is a mere matter of convention whether we call a given organism an animal or a plant. There is a living body called *Æthalium septicum*, which appears upon decaying vegetable substances, and, in one of its forms, is common upon the surfaces of tan-pits. In this condition it is, to ail intents and purposes, a fungus, and formerly was always regarded as such; but the remarkable investigations of De Bary have shown that, in another condition, the *Æthalium* is an actively locomotive creature, and [142] takes in solid matters, upon which, apparently, it feeds, thus exhibiting the most characteristic feature of animality. Is this a plant; or is it an animal? Is it both; or is it neither? Some decide in favour of the last supposition, and establish an. intermediate kingdom, a sort of biological No Man's Land for all these questionable forms. But, as it is admittedly impossible to draw any distinct boundary line between this no man's land and the vegetable world on the one hand, or the animal, on the other, it appears to me that this proceeding merely doubles the difficulty which, before, was single.

Protoplasm, simple or nucleated, is the formal basis of all life. It is the clay of the potter: which, bake it and paint it as he will, remains clay, separated by artifice, and not by nature, from the commonest brick or sun-dried clod.

Thus it becomes clear that all living powers are cognate, and that all living forms are fundamentally of one character. The researches of the chemist have revealed a no less striking uniformity of material composition in living matter.

In perfect strictness, it is true that chemical investigation can tell us little or nothing, directly, of the

composition of living matter, inasmuch as such matter must needs die in the act of analysis,–and upon this very obvious ground, objections, which I confess seem to me to be somewhat frivolous, have been raised to the drawing of any conclusions [143] whatever respecting the composition of actually living matter, from that of the dead matter of life, which alone is accessible to us. But objectors of this class do not seem to reflect that it is also, in strictness, true that we know nothing about the composition of any body whatever, as it is. The statement that a crystal of calc-spar consists of carbonate of lime, is quite true, if we only mean that, by appropriate processes, it may be resolved into carbonic acid and quicklime. If you pass the same carbonic acid over the very quicklime thus obtained, you will obtain carbonate of lime again, but it will not be calc-spar, nor anything like it. Can it, therefore, be said that chemical analysis teaches nothing about the chemical composition of calc-spar? Such a statement would be absurd; but it is hardly more so than the talk one occasionally hears about the uselessness of applying the results of chemical analysis to the living bodies which have yielded them.

One fact, at any rate, is out of reach of such refinements, and this is that all the forms of protoplasm which have yet been examined contain the four elements, carbon, hydrogen, oxygen, and nitrogen, in very complex union, and that they behave similarly towards several reagents. To this complex combination, the nature of which has never been determined with exactness, the name of Protein has been applied. And if we use this [144] term with such caution as may properly arise out of our comparative ignorance of the things for which it stands, it may be truly said, that all protoplasm is proteinaceous, or, as the white, or albumen, of an egg is one of the commonest examples of a nearly pure protein matter, we may say that all living matter is more or less albuminoid.

Perhaps it would not yet be safe to say that all forms of protoplasm are affected by the direct action of electric shocks; and yet the number of cases in which the contraction of protoplasm is shown to be affected by this agency increases every day.

Nor can it be affirmed with perfect confidence, that all forms of protoplasm are liable to undergo that peculiar coagulation at a temperature of 40°–50° centigrade, which has been called "heat-stiffening," though Kühne's beautiful researches have proved this occurrence to take place in so many and such diverse living beings, that it is hardly rash to expect that the law holds good for all.

Enough has, perhaps, been said to prove the existence of a general uniformity in the character of the protoplasm, or physical basis, of life, in whatever group of living beings it may be studied. But it will be understood that this general uniformity by no means excludes any amount of [145] special modifications of the fundamental substance. The mineral, carbonate of lime, assumes an immense diversity of characters, though no one doubts that, under all these Protean changes, it is one and the same thing.

And now, what is the ultimate fate, and what the origin, of the matter of life?

Is it, as some of the older naturalists supposed, diffused throughout the universe in molecules, which are indestructible and unchangeable in themselves, but, in endless transmigration, unite in innumerable permutations, into the diversified forms of life we know? Or, is the matter of life composed of ordinary

matter, differing from it only in the manner in which its atoms are aggregated? Is it built up of ordinary matter, and again resolved into ordinary matter when its work is done?

Modern science does not hesitate a moment between these alternatives. Physiology writes over the portals of life–

"Debemur morti nos nostraque,"

with a profounder meaning than the Roman poet attached to that melancholy line. Under whatever disguise it takes refuge, whether fungus or oak, worm or man, the living protoplasm not only ultimately dies and is resolved into its mineral and lifeless constituents, but is always dying, and, strange as the paradox may sound, could not live unless it died.

[146] In the wonderful story of the "Peau de Chagrin," the hero becomes possessed of a magical wild ass' skin, which yields him the means of gratifying all his wishes. But its surface represents the duration of the proprietor's life; and for every satisfied desire the skin shrinks in proportion to the intensity of fruition, until at length life and the last handbreadth of the *peau de chagrin*, disappear with the gratification of a last wish.

Balzac's studies had led him over a wide range of thought and speculation, and his shadowing forth of physiological truth in this strange story may have been intentional. At any rate, the matter of life is a veritable *peau de chagrin*, and for every vital act it is somewhat the smaller. All work implies waste, and the work of life results, directly or indirectly, in the waste of protoplasm.

Every word uttered by a speaker costs him some physical loss; and, in the strictest sense, he burns that others may have light–so much eloquence, so much of his body resolved into carbonic acid, water, and urea. It is clear that this process of expenditure cannot go on for ever. But, happily, the protoplasmic *peau de chagrin* differs from Balzac's in its capacity of being repaired, and brought back to its full size, after every exertion.

For example, this present lecture, whatever its intellectual worth to you, has a certain physical value to me, which is, conceivably, expressible by [147] the number of grains of protoplasm and other bodily substance wasted in maintaining my vital processes during its delivery. My *peau de chagrin* will be distinctly smaller at the end of the discourse than it was at the beginning. By and by, I shall probably have recourse to the substance commonly called mutton, for the purpose of stretching it back to its original size. Now this mutton was once the living protoplasm, more or less modified, of another animal–a sheep. As I shall eat it, it is the same matter altered, not only by death, but by exposure to sundry artificial operations in the process of cooking.

But these changes, whatever be their extent, have not rendered it incompetent to resume its old functions as matter of life. A singular inward laboratory, which I possess, will dissolve a certain portion of the modified protoplasm; the solution so formed will pass into my veins; and the subtle influences to which

it will then be subjected will convert the dead protoplasm into living protoplasm, and transubstantiate sheep into man.

Nor is this all. If digestion were a thing to be trifled with, I might sup upon lobster, and the matter of life of the crustacean would undergo the same wonderful metamorphosis into humanity. And were I to return to my own place by sea, and undergo shipwreck, the crustacean might, and probably would, return the compliment, and demonstrate our common nature by turning my [148] protoplasm into living lobster. Or, if nothing better were to be had, I might supply my wants with mere bread, and I should find the protoplasm of the wheat-plant to be convertible into man, with no more trouble than that of the sheep, and with far less, I fancy, than that of the lobster.

Hence it appears to be a matter of no great moment what animal or what plant, I lay under contribution for protoplasm, and the fact speaks volumes for the general identity of that substance in all living beings. I share this catholicity of assimilation with other animals, all of which, so far as we know, could thrive equally well on the protoplasm of any of their fellows, or of any plant; but here the assimilative powers of the animal world cease. A solution of smelling-salts in water, with an infinitesimal proportion of other saline matters, contains all the elementary bodies which enter into the composition of protoplasm; but, as I need hardly say, a hogshead of that fluid would not keep a hungry man from starving, nor would it save any animal whatever from a like fate. An animal cannot make protoplasm, but must take it ready-made from some other animal, or some plant–the animal's highest feat of constructive chemistry being to convert dead protoplasm into that living matter of life which is appropriate to itself.

Therefore, in seeking for the origin of protoplasm, we must eventually turn to the vegetable [149] world. A fluid containing carbonic acid, water, and nitrogenous salts, which offers such a Barmecide feast to the animal, is a table richly spread to multitudes of plants; and, with a due supply of only such materials, many a plant will not only maintain itself in vigour, but grow and multiply until it has increased a million-fold, or a million million-fold, the quantity of protoplasm which it originally possessed; in this way building up the matter of life, to an indefinite extent, from the common matter of the universe.

Thus, the animal can only raise the complex substance of dead protoplasm to the higher power, as one may say, of living protoplasm; while the plant can raise the less complex substances–carbonic acid, water, and nitrogenous salts–to the same stage of living protoplasm, if not to the same level. But the plant also has its limitations. Some of the fungi, for example, appear to need higher compounds to start with; and no known plant can live upon the uncompounded elements of protoplasm. A plant supplied with pure carbon, hydrogen, oxygen, and nitrogen, phosphorus, sulphur, and the like, would as infallibly die as the animal in his bath of smelling-salts, though it would be surrounded by all the constituents of protoplasm. Nor, indeed, need the process of simplification of vegetable food be carried so far as this, in order to arrive at the limit of the plant's thaumaturgy. Let water, carbonic acid, and all [150] the other needful constituents be supplied except nitrogenous salts, and an ordinary plant will still be unable to manufacture protoplasm.

Thus the matter of life, so far as we know it (and we have no right to speculate on any other), breaks up,

in consequence of that continual death which is the condition of its manifesting vitality, into carbonic acid, water, and nitrogenous compounds, which certainly possess no properties but those of ordinary matter. And out of these same forms of ordinary matter, and from none which are simpler, the vegetable world builds up all the protoplasm which keeps the animal world a-going. Plants are the accumulators of the power which animals distribute and disperse.

But it will be observed, that the existence of the matter of life depends on the pre-existence of certain compounds; namely, carbonic acid, water, and certain nitrogenous bodies. Withdraw any one of these three from the world, and all vital phænomena come to an end. They are as necessary to the protoplasm of the plant, as the protoplasm of the plant is to that of the animal. Carbon, hydrogen, oxygen, and nitrogen are all lifeless bodies. Of these, carbon and oxygen unite in certain proportions and under certain conditions, to give rise to carbonic acid; hydrogen and oxygen produce water; nitrogen and other elements give rise to nitrogenous salts. These new compounds, like the elementary bodies of which they are [151] composed, are lifeless. But when they are brought together, under certain conditions, they give rise to the still more complex body, protoplasm, and this protoplasm exhibits the phænomena of life.

I see no break in this series of steps in molecular complication, and I am unable to understand why the language which is applicable to any one term of the series may not be used to any of the others. We think fit to call different kinds of matter carbon, oxygen, hydrogen, and nitrogen, and to speak of the various powers and activities of these substances as the properties of the matter of which they are composed.

When hydrogen and oxygen are mixed in a certain proportion, and an electric spark is passed through them, they disappear, and a quantity of water, equal in weight to the sum of their weights, appears in their place. There is not the slightest parity between the passive and active powers of the water and those of the oxygen and hydrogen which have given rise to it. At 32° Fahrenheit, and far below that temperature, oxygen and hydrogen are elastic gaseous bodies, whose particles tend to rush away from one another with great force. Water, at the same temperature, is a strong though brittle solid whose particles tend to cohere into definite geometrical shapes, and sometimes build up frosty imitations of the most complex forms of vegetable foliage.

Nevertheless we call these, and many other [152] strange phænomena, the properties of the water, and we do not hesitate to believe that, in some way or another, they result from the properties of the component elements of the water. We do not assume that a something called "aquosity" entered into and took possession of the oxidated hydrogen as soon as it was formed, and then guided the aqueous particles to their places in the facets of the crystal, or amongst the leaflets of the hoar-frost. On the contrary, we live in the hope and in the faith that, by the advance of molecular physics, we shall by and by be able to see our way as clearly from the constituents of water to the properties of water, as we are now able to deduce the operations of a watch from the form of its parts and the manner in which they are put together.

Is the case in any way changed when carbonic acid, water, and nitrogenous salts disappear, and in their

place, under the influence of pre-existing living protoplasm, an equivalent weight of the matter of life makes its appearance?

It is true that there is no sort of parity between the properties of the components and the properties of the resultant, but neither was there in the case of the water. It is also true that what I have spoken of as the influence of pre-existing living matter is something quite unintelligible; but does anybody quite comprehend the *modus operandi* of an electric spark, which traverses a mixture of oxygen and hydrogen?

[153] What justification is there, then, for the assumption of the existence in the living matter of a something which has no representative, or correlative, in the not living matter which gave rise to it? What better philosophical status has "vitality" than "aquosity"? And why should "vitality" hope for a better fate than the other "itys" which have disappeared since Martinus Scriblerus accounted for the operation of the meat-jack by its inherent "meat-roasting quality," and scorned the "materialism" of those who explained the turning of the spit by a certain mechanism worked by the draught of the chimney.

If scientific language is to possess a definite and constant signification wherever it is employed, it seems to me that we are logically bound to apply to the protoplasm, or physical basis of life, the same conceptions as those which are held to be legitimate elsewhere. If the phænomena exhibited by water are its properties, so are those presented by protoplasm, living or dead, its properties.

If the properties of water may be properly said to result from the nature and disposition of its component molecules, I can find no intelligible ground for refusing to say that the properties of protoplasm result from the nature and disposition of its molecules.

But I bid you beware that, in accepting these conclusions, you are placing your feet on the first [154] rung of a ladder which, in most people's estimation, is the reverse of Jacob's, and leads to the antipodes of heaven. It may seem a small thing to admit that the dull vital actions of a fungus, or a foraminifer, are the properties of their protoplasm, and are the direct results of the nature of the matter of which they are composed. But if, as I have endeavoured to prove to you, their protoplasm is essentially identical with, and most readily converted into, that of any animal, I can discover no logical halting-place between the admission that such is the case, and the further concession that all vital action may, with equal propriety, be said to be the result of the molecular forces of the protoplasm which displays it. And if so, it must be true, in the same sense and to the same extent, that the thoughts to which I am now giving utterance, and your thoughts regarding them, are the expression of molecular changes in that matter of life which is the source of our other vital phænomena.

Past experience leads me to be tolerably certain that, when the propositions I have just placed before you are accessible to public comment and criticism, they will be condemned by many zealous persons, and perhaps by some few of the wise and thoughtful. I should not wonder if "gross and brutal materialism" were the mildest phrase applied to them in certain quarters. And, most [155] undoubtedly, the terms of the propositions are distinctly materialistic. Nevertheless two things are certain; the one, that I hold the

statements to be substantially true: the other, that I, individually, am no materialist, but, on the contrary, believe materialism to involve grave philosophical error.

This union of materialistic terminology with the repudiation of materialistic philosophy, I share with some of the most thoughtful men with whom I am acquainted. And, when I first undertook to deliver the present discourse, it appeared to me to be a fitting opportunity to explain how such a union is not only consistent with, but necessitated by, sound logic. I purposed to lead you through the territory of vital phænomena to the materialistic slough in which you find yourselves now plunged, and then to point out to you the sole path by which, in my judgment, extrication is possible.

An occurrence of which I was unaware until my arrival here last night renders this line of argument singularly opportune. I found in your papers the eloquent address "On the Limits of Philosophical Inquiry," which a distinguished prelate of the English Church delivered before the members of the Philosophical Institute on the previous day. My argument, also, turns upon this very point of the limits of philosophical inquiry; and I cannot bring out my own views better than by contrasting them with those so plainly and, in [156] the main, fairly stated by the Archbishop of York.

But I may be permitted to make a preliminary comment upon an occurrence that greatly astonished me. Applying the name of the "New Philosophy" to that estimate of the limits of philosophical inquiry which I, in common with many other men of science, hold to be just, the Archbishop opens his address by identifying this "New Philosophy" with the Positive Philosophy of M. Comte (of whom he speaks as its "founder"); and then proceeds to attack that philosopher and his doctrines vigorously.

Now, so far as I am concerned, the most reverend prelate might dialectically hew M. Comte in pieces, as a modern Agag, and I should not attempt to stay his hand. In so far as my study of what specially characterises the Positive Philosophy has led me, I find therein little or nothing of any scientific value, and a great deal which is as thoroughly antagonistic to the very essence of science as anything in ultramontane Catholicism. In fact, M. Comte's philosophy, in practice, might be compendiously described as Catholicism *minus* Christianity.

But what has Comtism to do with the "New Philosophy," as the Archbishop defines it in the following passage?

"Let me briefly remind you of the leading principle of this new philosophy.

[157]"All knowledge is experience of facts acquired by the senses. The traditions of older philosophies have obscured our experience by mixing with it much that the senses cannot observe, and until these additions are discarded our knowledge is impure. Thus metaphysics tell us that one fact which we observe is a cause, and another is the effect of that cause; but, upon a rigid analysis, we find that our senses observe nothing of cause or effect: they observe, first, that one fact succeeds another, and, after some opportunity, that this fact has never failed to follow–that for cause and effect we should substitute invariable succession. An older philosophy teaches us to define an object by distinguishing its essential from its accidental qualities but experience knows nothing of essential and accidental, she sees only that certain marks attach to an object, and, after many observations, that

some of them attach invariably whilst others may at times be absent... As all knowledge is relative, the notion of anything being necessary must be banished with other traditions."[2]

There is much here that expresses the spirit of the "New Philosophy," if by that term be meant the spirit of modern science; but I cannot but marvel that the assembled wisdom and learning of Edinburgh should have uttered no sign of dissent, when Comte was declared to be the founder of these doctrines. No one will accuse Scotchmen of habitually forgetting their great countrymen; but it was enough to make David Hume turn in his grave, that here, almost within ear-shot of his house, an instructed audience should have listened, without a murmur, while his most characteristic doctrines were attributed to a [158] French writer of fifty years later date, in whose dreary and verbose pages we miss alike the vigour of thought and the exquisite clearness of style of the man whom I make bold to term the most acute thinker of the eighteenth century–even though that century produced Kant.

But I did not come to Scotland to vindicate the honour of one of the greatest men she has ever produced. My business is to point out to you that the only way of escape out of the "crass materialism" in which we just now landed, is the adoption and strict working-out of the very principles which the Archbishop holds up to reprobation.

Let us suppose that knowledge is absolute, and not relative, and therefore, that our conception of matter represents that which it really is. Let us suppose, further, that we do know more of cause and effect than a certain definite order of succession among facts, and that we have a knowledge of the necessity of that succession–and hence, of necessary laws–and I, for my part, do not see what escape there is from utter materialism and necessarianism. For it is obvious that our knowledge of what we call the material world is, to begin with, at least as certain and definite as that of the spiritual world, and that our acquaintance with law is of as old a date as our knowledge of spontaneity. Further, I take it to be demonstrable that it is utterly impossible to prove that anything what[159]ever may not be the effect of a material and necessary cause, and that human logic is equally incompetent to prove that any act is really spontaneous. A really spontaneous act is one which, by the assumption, has no cause; and the attempt to prove such a negative as this is, on the face of the matter, absurd. And while it is thus a philosophical impossibility to demonstrate that any given phænomenon is not the effect of a material cause, any one who is acquainted with the history of science will admit, that its progress has, in all ages, meant, and now, more than ever, means, the extension of the province of what we call matter and causation, and the concomitant gradual banishment from all regions of human thought of what we call spirit and spontaneity.

I have endeavoured, in the first part of this discourse, to give you a conception of the direction towards which modern physiology is tending; and I ask you, what is the difference between the conception of life as the product of a certain disposition of material molecules, and the old notion of an Archæus governing and directing blind matter within each living body, except this–that here, as elsewhere, matter and law have devoured spirit and spontaneity? And as surely as every future grows out of past and present, so will the physiology of the future gradually extend the realm of matter and law until it is co-extensive with knowledge, with feeling, and with action.

[160] The consciousness of this great truth weighs like a nightmare, I believe, upon many of the best minds of these days. They watch what they conceive to be the progress of materialism, in such fear and powerless anger as a savage feels, when, during an eclipse, the great shadow creeps over the face of the sun. The advancing tide of matter threatens to drown their souls; the tightening grasp of law impedes their freedom; they are alarmed lest man's moral nature be debased by the increase of his wisdom.

If the "New Philosophy" be worthy of the reprobation with which it is visited, I confess their fears seem to me to be well founded. While, on the contrary, could David Hume be consulted, I think he would smile at their perplexities, and chide them for doing even as the heathen, and falling down in terror before the hideous idols their own hands have raised.

For, after all, what do we know of this terrible "matter," except as a name for the unknown and hypothetical cause of states of our own consciousness? And what do we know of that "spirit" over whose threatened extinction by matter a great lamentation is arising, like that which was heard at the death of Pan, except that it is also a name for an unknown and hypothetical cause, or condition, of states of consciousness? In other words, matter and spirit are but names for the imaginary substrata of groups of natural phænomena.

[161] And what is the dire necessity and "iron" law under which men groan? Truly, most gratuitously invented bugbears. I suppose if there be an "iron" law, it is that of gravitation; and if there be a physical necessity, it is that a stone, unsupported, must fall to the ground. But what is all we really know, and can know, about the latter phænomena? Simply, that, in all human experience, stones have fallen to the ground under these conditions; that we have not the smallest reason for believing that any stone so circumstanced will not fall to the ground; and that we have, on the contrary, every reason to believe that it will so fall. It is very convenient to indicate that all the conditions of belief have been fulfilled in this case, by calling the statement that unsupported stones will fall to the ground, "a law of Nature." But when, as commonly happens, we change *will* into *must,* we introduce an idea of necessity which most assuredly does not lie in the observed facts, and has no warranty that I can discover elsewhere. For my part, I utterly repudiate and anathematise the intruder. Fact I know; and Law I know; but what is this Necessity, save an empty shadow of my own mind's throwing?

But, if it is certain that we can have no knowledge of the nature of either matter or spirit, and that the notion of necessity is something illegitimately thrust into the perfectly legitimate [162] conception of law, the materialistic position that there is nothing in the world but matter, force, and necessity, is as utterly devoid of justification as the most baseless of theological dogmas. The fundamental doctrines of materialism, like those of spiritualism, and most other "isms," lie outside "the limits of philosophical inquiry," and David Hume's great service to humanity is his irrefragable demonstration of what these limits are. Hume called himself a sceptic, and therefore others cannot be blamed if they apply the same title to him; but that does not alter the fact that the name, with its existing implications, does him gross injustice.

If a man asks me what the politics of the inhabitants of the moon are, and I reply that I do not know; that

neither I, nor any one else, has any means of knowing; and that, under these circumstances, I decline to trouble myself about the subject at all, I do not think he has any right to call me a sceptic. On the contrary, in replying thus, I conceive that I am simply honest and truthful, and show a proper regard for the economy of time. So Hume's strong and subtle intellect takes up a great many problems about which we are naturally curious, and shows us that they are essentially questions of lunar politics, in their essence incapable of being answered, and therefore not worth the attention of men who have work to do in the world. And he thus ends one of his essays:–-

[163] "If we take in hand any volume of Divinity, or school metaphysics, for instance, let us ask, *Does it contain any abstract reasoning concerning quantity or number?* No. *Does it contain any experimental reasoning concerning matter of fact and existence?* No. Commit it then to the flames; for it can contain nothing but sophistry and illusion."[3]

Permit me to enforce this most wise advice. Why trouble ourselves about matters of which, however important they may be, we do know nothing, and can know nothing? We live in a world which is full of misery and ignorance, and the plain duty of each and all of us is to by to make the little corner he can influence somewhat less miserable and somewhat less ignorant than it was before he entered it. To do this effectually it is necessary to be fully possessed of only two beliefs: the first, that the order of Nature is ascertainable by our faculties to an extent which is practically unlimited; the second, that our volition counts for something as a condition of the course of events.[4]

Each of these beliefs can be verified experimentally, as often as we like to try. Each, therefore, stands upon the strongest foundation upon which any belief can rest, and forms one of our highest [164] truths. If we find that the ascertainment of the order of nature is facilitated by using one terminology, or one set of symbols, rather than another, it is our clear duty to use the former; and no harm can accrue, so long as we bear in mind, that we are dealing merely with terms and symbols.

In itself it is of little moment whether we express the phænomena of matter in terms of spirit; or the phænomena of spirit in terms of matter: matter may be regarded as a form of thought, thought may be regarded as a property of matter–each statement has a certain relative truth. But with a view to the progress of science, the materialistic terminology is in every way to be preferred. For it connects thought with the other phænomena of the universe, and suggests inquiry into the nature of those physical conditions, or concomitants of thought, which are more or less accessible to us, and a knowledge of which may, in future, help us to exercise the same kind of control over the world of thought, as we already possess in respect of the material world; whereas, the alternative, or spiritualistic, terminology is utterly barren, and leads to nothing but obscurity and confusion of ideas.

Thus there can be little doubt, that the further science advances, the more extensively and consistently will all the phænomena of Nature be represented by materialistic formulae and symbols.

[165] But the man of science, who, forgetting the limits of philosophical inquiry, slides from these formulae and symbols into what is commonly understood by materialism, seems to me to place himself

on a level with the mathematician, who should mistake the *x*'s and *y*'s with which he works his problems, for real entities–and with this further disadvantage, as compared with the mathematician, that the blunders of the latter are of no practical consequence, while the errors of systematic materialism may paralyse the energies and destroy the beauty of a life.

[I cannot say I have ever had to complain of lack of hostile criticism; but the preceding essay has come in for more than its fair share of that commodity. It may be well, therefore, for the general reader to study, in connection with it, the first chapter of the standard "Textbook of Physiology," by Dr. Foster, making fair allowance for the rapid progress of knowledge during the last quarter of a century. 1892.]

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[1] [The substance of this paper was contained in a discourse which was delivered in Edinburgh on the evening of Sunday, the 8th of November, 1868–being the first of a series of Sunday evening addresses upon non-theological topics, instituted by the Rev. J. Cranbrook. Some phrases, which could possess only a transitory and local interest have been omitted; instead of the newspaper report of the Archbishop of York's address, his Grace's subsequently published pamphlet *On the Limits of Philosophical Inquiry* is quoted; and I have, here and there, endeavoured to express my meaning more fully and clearly than I seem to have done in speaking–if I may judge by sundry criticisms upon what I am supposed to have said, which have appeared. But in substance, and, so far as my recollection serves, in form, what is here written corresponds with what was there said.]

[2] *The Limits of Philosophical Inquiry*, pp. 4 and 5.

[3] Hume's Essay "Of the Academical or Sceptical Philosophy," in the *Inquiry concerning the Human Understanding*.–[Many critics of this passage seem to forget that the subject-matter of Ethics and Æsthetics consists of matters of fact and existence.–1892].

[4] Or, to speak more accurately, the physical state of which volition is the expression.–[1892].

GRAND ECLECTIC SYMPOSIUM AND ÆSTHETIC SOIRÉE.

PROGRAMME.

Opening Chorus.

The Universal Prayer . *Pope* . Music by an Amateur.

Address by the Noble the President.

On the Invalidity of the Arguments in favor of Objective Divinity.

Quadrille.

Orphée aux enfers . . Arranged by Mr. BALSHAZZAR.

Lecture.

The Hippocampus Minor and its relation to the Mosaic Cosmogony . . } By Prof. FOXLEY, F.R.S.

Song.

"Foot it featly hear and there" . . By Mrs. DE TERINNE.

Valse.

Mephistophilienne . . *Faust.*

Address.

The Idolism of Tradition, or the Irrational in Sexual Probabilities . . } By Prof. MACMANUS, F.R.S., F.G.S., F.L.S.

Polka.

Der Freyschütz . . . Arranged by VON TEUFEL.

A LUCID INTERVAL.

Refreshment?

Menu?

Huîtres à Voltaire.
Saumon à la Tartare.
[illegible]
Lentilles Pythagoriennes.
Choux [illegible].
Dindon [illegible].
Poulets froids à l'école de philosophe.
Filets des enfans humains, au sélection naturel.
Rosbif [illegible].
Oignons brûlés éclectiques.
Compotes de Corinthe.
Soufflés idéalogiques.
Pâtés de foie gras.

Address.

Protoplastic Chaos; or the Antecedents of Life and Order . . . . . } By Lady BANTAM.

Galop.

"John Brown's soul marching on" . . . By DIDEREL.

Function Epilogue.

God and Gammon . . By the Rev. INFELIX NOSEY, B.A.

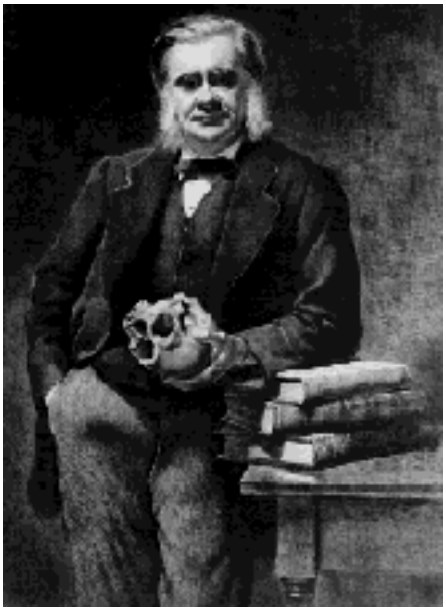
Finale.

Benediction Sonnet . . By a Distinguished American.

Professor Foxley

Jenkins, John E., *Lord Bantam* (1872)

THE HUXLEY FILE



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C. Blinderman & D. Joyce
Clark University

On Descartes' "Discourse Touching the Method of Using One's Reason Rightly and of Seeking Scientific Truth" (1870)

Collected Essays I

[166] It has been well said that "all the thoughts of men, from the beginning of the world until now, are linked together into one great chain;" but the conception of the intellectual filiation of mankind which is expressed in these words may, perhaps, be more fitting metaphor. The thoughts of men seem rather to be comparable to the leaves, flowers, and fruit upon the innumerable branches of a few great stems, fed by commingled and hidden roots. These stems bear the names of the half-a-dozen men, endowed with intellects of heroic force and clearness, to whom we are led, at whatever point of the world of thought the attempt to trace its [167] history commences, just as certainly as the following up the small twigs of a tree to the branchlets which bear them, and tracing the branchlets to their supporting branches, brings us, sooner or later, to the bole.

It seems to me that the thinker who, more than any other, stands in the relation of such a stem towards the philosophy and the science of the modern world is Réné Descartes. I mean, that if you lay hold of any characteristic product of modern ways of thinking, either in the region of philosophy, or in that of science, you find the spirit of that thought, if not its form, to have been present in the mind of the great Frenchman.

There are some men who are counted great because they represent the actuality of their own age, and mirror it as it is. Such an one was Voltaire, of whom it was epigrammatically said, "he expressed everybody's thoughts better than anybody."[1] But there are other men who attain greatness because they embody the potentiality of their own day, and magically reflect the future. They express the thoughts which will be everybody's two or three centuries after them. Such an one was Descartes.

Born in 1596, nearly three hundred years ago, of a noble family in Touraine, Réné Descartes grew up into a sickly and diminutive child, whose [168] keen wit soon gained him that title of "the Philosopher," which, in the mouths of his noble kinsmen, was more than half a reproach. The best schoolmasters of the day, the Jesuits, educated him as well as a French boy of the seventeenth century could be educated. And they must have done their work honestly and well, for, before his schoolboy days were over, he had discovered that the most of what he had learned, except in mathematics, was devoid of solid and real value.

"Therefore," says he, in that 'Discourse'[2] which I have taken for my text, "as soon as I was old enough to be set free from the government of my teachers, I entirely forsook the study of letters; and determining to seek no other knowledge than that which I could discover within myself, or in the great book of the world, I spent the remainder of my youth in travelling; in seeing courts and armies; in the society of people of different humours and conditions; in gathering varied experience; in testing myself by the chances of fortune; and in always trying to profit by my reflections on what happened. . . . And I always had an intense desire to learn how to distinguish

truth from falsehood, in order to be clear about my actions, and to walk surefootedly in this life."

But "learn what is true, in order to do what is right," is the summing up of the whole duty of man, for all who are unable to satisfy their mental hunger with the east wind of authority; and to those of us moderns who are in this position, it is one of Descartes' great claims to our reverence as [169] a spiritual ancestor, that, at three-and-twenty, he saw clearly that this was his duty, and acted up to his conviction. At two-and-thirty, in fact, finding all other occupations incompatible with the search after the knowledge which leads to action, and being possessed of a modest competence, he withdrew into Holland; where he spent nine years in learning and thinking, in such retirement that only one or two trusted friends knew of his whereabouts.

In 1637 the first-fruits of these long meditations were given to the world in the famous "Discourse touching the Method of using Reason rightly and of seeking Scientific Truth," which, at once an autobiography and a philosophy, clothes the deepest thought in language of exquisite harmony, simplicity, and clearness.

The central propositions of the whole "Discourse" are these. There is a path that leads to truth so surely, that any one who will follow it must needs reach the goal, whether his capacity be great or small. And there is one guiding rule by which a man may always find this path, and keep himself from straying when he has found it. This golden rule is–give unqualified assent to no propositions but those the truth of which is so clear and distinct that they cannot be doubted.

The enunciation of this great first commandment of science consecrated Doubt. It removed Doubt from the seat of penance among the [170] grievous sins to which it had long been condemned, and enthroned it in that high place among the primary duties, which is assigned to it by the scientific conscience of these latter days. Descartes was the first among the moderns to obey this commandment deliberately; and, as a matter of religious duty, to strip off all his beliefs and reduce himself to a state of intellectual nakedness, until such time as he could satisfy himself which were fit to be worn. He thought a bare skin healthier than the most respectable and well-cut clothing of what might, possibly, be mere shoddy.

When I say that Descartes consecrated doubt, you must remember that it was that sort of doubt which Goethe has called "the active scepticism, whose whole aim is to conquer itself; "[3] and not that other sort which is born of flippancy and ignorance, and whose aim is only to perpetuate itself, as an excuse for idleness and indifference. But it is impossible to define what is meant by scientific doubt better than in Descartes' own words. After describing the gradual progress of his negative criticism, he tells us:–

"For all that, I did not imitate the sceptics, who doubt only for doubting's sake, and pretend to be always undecided; on the contrary, my whole intention was to arrive at a certainty, and to dig away the drift and the sand until I reached the rock or the clay beneath."

[171] And further, since no man of common sense when he pulls down his house for the purpose of rebuilding it, fails to provide himself with some shelter while the work is in progress; so, before

demolishing the spacious, if not commodious, mansion of his old beliefs, Descartes thought it wise to equip himself with what he calls "*une morale par provision*," by which he resolved to govern his practical life until such time as he should be better instructed. The laws of this "provisional self-government" are embodied in four maxims, of which one binds our philosopher to submit himself to the laws and religion in which he was brought up; another, to act, on all those occasions which call for action, promptly and according to the best of his judgment, and to abide, without repining, by the result: a third rule is to seek happiness in limiting his desires, rather than in attempting to satisfy them; while the last is to make the search after truth the business of his life.

Thus prepared to go on living while he doubted, Descartes proceeded to face his doubts like a man. One thing was clear to him, he would not lie to himself–would, under no penalties, say, "I am sure" of that of which he was not sure; but would go on digging and delving until he came to the solid adamant or, at worst, made sure there was [172] no adamant. As the record of his progress tells us, he was obliged to confess that life is full of delusions; that authority may err; that testimony may be false or mistaken; that reason lands us in endless fallacies; that memory is often as little trustworthy as hope; that the evidence of the very senses may be misunderstood; that dreams are real as long as they last, and that what we call reality may be a long and restless dream. Nay, it is conceivable that some powerful and malicious being may find his pleasure in deluding us, and in making us believe the thing which is not, every moment of our lives. What, then, is certain? What even, if such a being exists, is beyond the reach of his powers of delusion? Why, the fact that the thought, the present consciousness, exists. Our thoughts may be delusive, but they cannot be fictitious. As thoughts, they are real and existent, and the cleverest deceiver cannot make them otherwise.

Thus, thought is existence. More than that, so far as we are concerned, existence is thought, all our conceptions of existence being some kind or other of thought. Do not for a moment suppose that these are mere paradoxes or subtleties. A little reflection upon the commonest facts proves them to be irrefragable truths. For example, I take up a marble, and I find it to be a red, round, hard, single body. We call the redness, the roundness, the hardness, and the singleness, [173] "qualities" of the marble; and it sounds, at first, the height of absurdity to say that all these qualities are modes of our own consciousness, which cannot even be conceived to exist in the marble. But consider the redness, to begin with. How does the sensation of redness arise? The waves of a certain very attenuated matter, the particles of which are vibrating with vast rapidity, but with very different velocities, strike upon the marble, and those which vibrate with one particular velocity are thrown off from its surface in all directions. The optical apparatus of the eye gathers some of these together, and gives them such a course that they impinge upon the surface of the retina, which is a singularly delicate apparatus connected with the termination of the fibres of the optic nerve. The impulses of the attenuated matter, or ether, affect this apparatus and the fibres of the optic nerve in a certain way; and the change in the fibres of the optic nerve produces yet other changes in the brain; and these, in some fashion unknown to us, give rise to the feeling, or consciousness of redness. If the marble could remain unchanged, and either the rate of vibration of the ether, or the nature of the retina, could be altered, the marble would seem not red, but some other colour. There are many people who are what are called colour-blind, being unable to distinguish one colour from another. Such an one might declare our marble to be [174] green; and he would be quite as right in saying that it is green, as we are in declaring it to be red. But then, as the

marble cannot, in itself, be both green and red, at the same time, this shows that the quality "redness" must be in our consciousness and not in the marble.

In like manner, it is easy to see that the roundness and the hardness are forms of our consciousness, belonging to the groups which we call sensations of sight and touch. If the surface of the cornea were cylindrical, we should have a very different notion of a round body from that which we possess now; and if the strength of the fabric, and the force of the muscles, of the body were increased a hundredfold, our marble would seem to be as soft as a pellet of bread crumbs.

Not only is it obvious that all these qualities are in us, but, if you will make the attempt, you will find it quite impossible to conceive of "blueness," "roundness," and "hardness" as existing without reference to some such consciousness as our own. It may seem strange to say that even the "singleness" of the marble is relative to us; but extremely simple experiments will show that such is veritably the case, and that our two most trustworthy senses may be made to contradict one another on this very point. Hold the marble between the finger and thumb, and look at it in the ordinary way. Sight and touch agree [175] that it is single. Now squint, and sight tells you that there are two marbles, while touch asserts that there is only one. Next, return the eyes to their natural position, and, having crossed the forefinger and the middle finger, put the marble between their tips. Then touch will declare that there are two marbles, while sight says that there is only one; and touch claims our belief, when we attend to it, just as imperatively as sight does.

But it may be said, the marble takes up a certain space which could not be occupied, at the same time, by anything else. In other words, the marble has the primary quality of matter, extension. Surely this quality must be in the thing and not in our minds? But the reply must still be; whatever may, or may not, exist in the thing, all that we can know of these qualities is a state of consciousness. What we call extension is a consciousness of a relation between two, or more, affections of the sense of sight, or of touch. And it is wholly inconceivable that what we call extension should exist independently of such consciousness as our own. Whether, notwithstanding this inconceivability, it does so exist, or not, is a point on which I offer no opinion. Thus, whatever our marble may be in itself, all that we can know of it is under the shape of a bundle of our own consciousnesses.

Nor is our knowledge of anything we know or [176] feel more, or less, than a knowledge of states of consciousness. And our whole life is made up of such states. Some of these states we refer to a cause we call "self;" others to a cause or causes which may be comprehended under the title of "not-self." But neither of the existence of "self," nor of that of "not-self," have we, or can we by any possibility have, any such unquestionable and immediate certainty as we have of the states of consciousness which we consider to be their effects. They are not immediately observed facts, but results of the application of the law of causation to those facts. Strictly speaking, the existence of a "self" and of a "not-self" are hypotheses by which we account for the facts of consciousness. They stand upon the same footing as the belief in the general trustworthiness of memory, and in the general constancy of the order of Nature–as hypothetical assumptions which cannot be proved, or known with that highest degree of certainty which is given by immediate consciousness; but which, nevertheless, are of the highest practical value, inasmuch as the conclusions logically drawn from them are always verified by experience.

This, in my judgment, is the ultimate issue of Descartes' argument; but it is proper for me to point out that we have left Descartes himself some way behind us. He stopped at the famous formula, "I think, therefore I am." Yet a little [177] consideration will show this formula to be full of snares and verbal entanglements. In the first place, the "therefore" has no business there. The "I am" is assumed in the "I think," which is simply another way of saying "I am thinking." And, in the second place, "I think" is not one simple proposition, but three distinct assertions rolled into one. The first of these is, "something called I exists;" the second is, "something called thought exists;" and the third is, "the thought is the result of the action of the I."

Now, it will be obvious to you, that the only one of these three propositions which can stand the Cartesian test of certainty is the second. It cannot be doubted, for the very doubt is an existent thought. But the first and third, whether true or not, may be doubted, and have been doubted. For the assertor may be asked, How do you know that thought is not self-existent; or that a given thought is not the effect of its antecedent thought, or of some external power? And a diversity of other questions, much more easily put than answered. Descartes, determined as he was to strip off all the garments which the intellect weaves for itself, forgot this gossamer shirt of the "self"; to the great detriment, and indeed ruin of his toilet when he began to clothe himself again.

But it is beside my purpose to dwell upon the minor peculiarities of the Cartesian philosophy. [178] All I wish to put clearly before your minds thus far, is that Descartes, having commenced by declaring doubt to be a duty, found certainty in consciousness alone; and that the necessary outcome of his views is what may properly be termed Idealism; namely, the doctrine that, whatever the universe may be, all we can know of it is the picture presented to us by consciousness. This picture may be a true likeness–though how this can be is inconceivable; or it may have no more resemblance to its cause than one of Bach's fugues has to the person who is playing it; or than a piece of poetry has to the mouth and lips of a reciter. It is enough for all the practical purposes of human existence if we find that our trust in the representations of consciousness is verified by results; and that, by their help, we are enabled "to walk surefootedly in this life."

Thus the method, or path which leads to truth, indicated by Descartes, takes us straight to the Critical Idealism of his great successor Kant. It is that Idealism which declares the ultimate fact of all knowledge to be consciousness, or, in other words, a mental phænomenon; and therefore affirms the highest of all certainties, and indeed the only absolute certainty, to be the existence of mind. But it is also that Idealism which refuses to make any assertions, either positive or negative, as to what lies beyond consciousness. It accuses the subtle Berkeley of stepping beyond [179] the limits of knowledge when he declared that a substance of matter does not exist; and of illogicality, for not seeing that the arguments which he supposed demolished the existence of matter were equally destructive to the existence of soul. And it refuses to listen to the jargon of more recent days about the "Absolute" and all the other hypostatised adjectives, the initial letters of the names of which are generally printed in capital letters; just as you give a Grenadier a bearskin cap, to make him look more formidable than he is by nature.

I repeat, the path indicated and followed by Descartes, which we have hitherto been treading, leads through doubt to that critical Idealism which lies at the heart of modern metaphysical thought. But the "Discourse" shows us another, and apparently very different, path, which leads, quite as definitely, to that correlation of all the phænomena of the universe with matter and motion, which lies at the heart of modern physical thought, and which most people call Materialism.

The early part of the seventeenth century, when Descartes reached manhood, is one of the great epochs of the intellectual life of mankind. At that time, physical science suddenly strode into the arena of public and familiar thought, and openly challenged not only Philosophy and the Church, but that common ignorance which often passes by the name of Common Sense. The assertion of the [180] motion of the earth was a defiance to all three, and Physical Science threw down her glove by the hand of Galileo.

It is not pleasant to think of the immediate result of the combat; to see the champion of science, old, worn, and on his knees before the Cardinal Inquisitor, signing his name to what he knew to be a lie. And, no doubt, the Cardinals rubbed their hands as they thought how well they had silenced and discredited their adversary. But two hundred years have passed, and however feeble or faulty her soldiers, Physical Science sits crowned and enthroned as one of the legitimate rulers of the world of thought. Charity children would be ashamed not to know that the earth moves; while the Schoolmen are forgotten; and the Cardinals–well, the Cardinals are at the Œcumenical Council, still at their old business of trying to stop the movement of the world.

As a ship, which having lain becalmed with every stitch of canvas set, bounds away before the breeze which springs up astern, so the mind of Descartes, poised in equilibrium of doubt, not only yielded to the full force of the impulse towards physical science and physical ways of thought, given by his great contemporaries, Galileo and Harvey, but shot beyond them; and anticipated, by bold speculation, the conclusions, which could only be placed upon a secure foundation by the labours of generations of workers.

[181] Descartes saw that the discoveries of Galileo meant that the remotest parts of the universe were governed by mechanical laws; while those of Harvey meant that the same laws presided over the operations of that portion of the world which is nearest to us, namely, our own bodily frame. And crossing the interval between the centre and its vast circumference by one of the great strides of genius, Descartes sought to resolve all the phænomena of the universe into matter and motion, or forces operating according to law.[4] This grand conception, which is sketched in the "Discours," and more fully developed in the "Principes" and in the "Traite de l'Homme," he worked out with extraordinary power and knowledge; and with the effect of arriving, in the last-named essay, at that purely mechanical view of vital phænomena towards which modern physiology is striving.

Let us try to understand how Descartes got into this path, and why it led him where it did. The mechanism of the circulation of the blood had evidently taken a great hold of his mind, as he describes it several times, at much length. After giving a full account of it in the "Discourse," and [182] erroneously ascribing the motion of the blood, not to the contraction of the walls of the heart, but to the heat which

he supposes to be generated there, he adds:–

"This motion, which I have just explained, is as much the necessary result of the structure of the parts which one can see in the heart, and of the heat which one may feel there with one's fingers, and of the nature of the blood, which may be experimentally ascertained; as is that of a clock of the force, the situation, and the figure, of its weight, and of its wheels."

But if this apparently vital operation were explicable as a simple mechanism, might not other vital operations be reducible to the same category? Descartes replies without hesitation in the affirmative.

"The animal spirits," says he, "resemble a very subtle fluid, or a very pure and vivid flame, and are continually generated in the heart, and ascend to the brain as to a sort of reservoir. Hence they pass into the nerves and are distributed to the muscles, causing contraction, or relaxation, according to their quantity."

Thus, according to Descartes, the animal body is an automaton, which is competent to perform all the animal functions in exactly the same way as a clock or any other piece of mechanism. As he puts the case himself:–

"In proportion as these spirits [the animal spirits] enter the cavities of the brain, they pass thence into the pores of its substance, and from these pores into the nerves; where, according as they enter, or even only tend to enter, more or less, into one than into another, they have the power of altering the figure [183] of the muscles into which the nerves are inserted, and by this means of causing all the limbs to move. Thus, as you may have seen in the grottoes and the fountains in royal gardens, the force with which the water issues from its reservoir is sufficient to move various machines, and even to make them play instruments, or pronounce words according to the different disposition of the pipes which lead the water.

"And, in truth, the nerves of the machine which I am describing may very well be compared to the pipes of these waterworks; its muscles and its tendons to the other various engines and springs which seem to move them; its animal spirits to the water which impels them, of which the heart is the fountain; while the cavities of the brain are the central office. Moreover, respiration and other such actions as are natural and usual in the body, and which depend on the course of the spirits, are like the movements of a clock, or of a mill, which may be kept up by the ordinary flow of the water.

"The external objects which, by their mere presence, act upon the organs of the senses; and which, by this means, determine the corporal machine to move in many different ways, according as the parts of the brain are arranged, are like the strangers who, entering into some of the grottoes of these waterworks, unconsciously cause the movements which take place in their presence. For they cannot enter without treading upon certain planks so arranged that, for example, if they approach a bathing Diana, they cause her to hide among the reeds; and if they attempt to follow her, they see approaching a Neptune, who threatens them with his trident: or if they try some other way, they cause some other monster, who vomits water into their faces, to dart out; or like contrivances, according to the fancy of the engineers who have made them. And lastly, when the *rational soul* is lodged in this machine, it will have its principal seat in the brain, and will take the place of the engineer, who ought to be in that part of the works with which all the pipes are connected, when he wishes to increase, or to slacken, or in some way to alter their movements."[5]

[184] And again still more strongly:–

"All the functions which I have attributed to this machine (the body), as the digestion of food, the pulsation of the heart and of the arteries; the nutrition and the growth of the limbs; respiration, wakefulness, and sleep; the reception of light, sounds, colours, flavours, heat, and such like qualities, in the organs of the external senses; the impression of the ideas of these in the organ of common sense and in the imagination; the retention, or the impression, of these ideas on the memory; the internal movements of the appetites and the passions; and lastly, the external movements of all the limbs, which follow so aptly, as well the action of the objects which are presented to the senses, as the impressions which meet in the memory, that they imitate as nearly as possible those of a real man:[6] I desire, I say, that you should consider that these functions in the machine naturally proceed from the mere arrangement of its organs, neither more nor less than do the movements of a clock, or other automation, from that of its weights and its wheels; so that, so far as these are concerned, it is not necessary to conceive any other vegetative or sensitive soul, nor any other principle of motion, or of life, than the blood and the spirits agitated by the fire which burns continually in the heart, and which is no wise essentially different from all the fires which exist in inanimate bodies."[7]

The spirit of these passages is exactly that of the most advanced physiology of the present day; all that is necessary to make them coincide with our present physiology in form, is to represent the details of the working of the animal machinery in [185] modern language, and by the aid of modern conceptions.

Most undoubtedly, the digestion of food in the human body is a purely chemical process; and the passage of the nutritive parts of that food into the blood, a physical operation. Beyond all question, the circulation of the blood is simply a matter of mechanism, and results from the structure and arrangement of the parts of the heart and vessels, from the contractility of those organs, and from the regulation of that contractility by an automatically acting nervous apparatus. The progress of physiology has further shown, that the contractility of the muscles and irritability of the nerves are purely the results of the molecular mechanism of those organs; and that the regular movements of the respiratory, alimentary, and other internal organs are governed and guided, as mechanically, by their appropriate nervous centres. The even rhythm of the breathing of every one of us depends upon the structural integrity of a particular region of the medulla oblongata, as much as the ticking of a clock depends upon the integrity of the escapement. You may take away the hands of a clock and break up its striking machinery, but it will still tick; and a man may be unable to feel, speak, or move, and yet he will breathe.

Again, in entire accordance with Descartes' affirmation, it is certain that the modes of motion [186] which constitute the physical basis of light, sound, and heat, are transmuted into affections of nervous matter by the sensory organs. These affections are, so to speak, a kind of physical ideas, which are retained in the central organs, constituting what might be called physical memory, and may be combined in a manner which answers to association and imagination, or may give rise to muscular contractions, in those "reflex actions" which are the mechanical representatives of volition.

Consider what happens when a blow is aimed at the eye.[8] Instantly, and without our knowledge or will, and even against the will, the eyelids close. What is it that happens? A picture of the rapidly advancing

fist is made upon the retina at the back of the eye. The retina changes this picture into an affection of a number of the fibres of the optic nerve; the fibres of the optic nerve affect certain parts of the brain; the brain, in consequence, affects those particular fibres of the seventh nerve which go to the orbicular muscle of the eyelids; the change in these nerve-fibres causes the muscular fibres to alter their dimensions, so as to become shorter and broader; and the result is the closing of the slit between the two lids, round which these fibres are disposed. Here is a pure mechanism, giving rise to a purposive action, and strictly comparable to that by which Descartes [187] supposes his waterwork Diana to be moved. But we may go further, and inquire whether our volition, in what we term voluntary action, ever plays any other part than that of Descartes' engineer, sitting in his office, and turning this tap or the other, as he wishes to set one or another machine in motion, but exercising no direct influence upon the movements of the whole.

Our voluntary acts consist of two parts: firstly, we desire to perform a certain action; and, secondly, we somehow set a-going a machinery which does what we desire. But so little do we directly influence that machinery, that nine-tenths of us do not even know of its existence. Suppose one wills to raise one's arm and whirl it round. Nothing is easier. But the majority of us do not know that nerves and muscles are concerned in this process; and the best anatomist among us would be amazingly perplexed, if he were called upon to direct the succession, and the relative strength, of the multitudinous nerve-changes, which are the actual causes of this very simple operation. So again in speaking. How many of us know that the voice is produced in the larynx, and modified by the mouth? How many among these instructed persons understand how the voice is produced and modified? And what living man, if he had unlimited control over all the nerves supplying the mouth and larynx of another [188] person, could make him pronounce a sentence? Yet, if one has anything to say, what is easier than to say it? We desire the utterance of certain words: we touch the spring of the word-machine, and they are spoken. Just as Descartes' engineer, when he wanted a particular hydraulic machine to play, had only to turn a tap, and what he wished was done. It is because the body is a machine that education is possible. Education is the formation of habits, a superinducing of an artificial organisation upon the natural organisation of the body; so that acts, which at first required a conscious effort, eventually became unconscious and mechanical. If the act which primarily requires a distinct consciousness and volition of its details, always needed the same effort, education would be an impossibility.

According to Descartes, then, all the functions which are common to man and animals are performed by the body as a mere mechanism, and he looks upon consciousness as the peculiar distinction of the "*chose pensante*," of the "rational soul," which in man (and in man only, in Descartes' opinion) is superadded to the body. This rational soul he conceived to be lodged in the pineal gland, as in a sort of central office; and here, by the intermediation of the animal spirits, it became aware of what was going on in the body, or influenced the operations of the body. Modern physiologists do not ascribe so exalted a function to the little [189] pineal gland,[9] but, in a vague sort of way, they adopt Descartes' principle, and suppose that the soul is lodged in the cortical part of the brain–at least this is commonly regarded as the seat an instrument of consciousness.

Descartes has clearly stated what he conceived to be the difference between spirit and matter. Matter is

substance which has extension, but does not think; spirit is substance which thinks, but has no extension. It is very hard to form a definite notion of what this phraseology means, when it is taken in connection with the location of the soul in the pineal gland; and I can only represent it to myself as signifying that the soul is a mathematical point, having place but not extension, within the limits of the pineal body. Not only has it place, but it must exert force; for, according to this hypothesis, it is competent, when it wills, to change the course of the animal spirits, which consist of matter in motion. Thus the soul becomes a centre of force. But, at the same time, the distinction between spirit and matter vanishes; inasmuch as matter, according to a tenable hypothesis, may be nothing but a multitude of centres of force. The case is worse if we adopt the modern vague notion that consciousness is seated in the grey matter of the cerebrum, generally; for, [190] as the grey matter has extension, that which is lodged in it must also have extension. And thus we are led, in another way, to lose spirit in matter.

In truth, Descartes' physiology, like the modern physiology of which it anticipates the spirit, leads straight to Materialism, so far as that title is rightly applicable to the doctrine that we have no knowledge of any thinking substance, apart from extended substance; and that thought is as much a function of matter as motion is. Thus we arrive at the singular result that, of the two paths opened up to us in the "Discourse upon Method," the one leads, by way of Berkeley and Hume, to Kant and Idealism; while the other leads, by way of De La Mettrie and Priestley, to modern physiology and Materialism.[10] Our stem divides into two main branches, which grow in opposite ways, and bear flowers which look as different as they can well be. But each branch is sound and healthy and has as much life and vigour as the other.

If a botanist found this state of things in a new plant, I imagine that he might be inclined to think that his tree was monœcious–that the [191] flowers were of different sexes, and that, so far from setting up a barrier between the two branches of the tree, the only hope of fertility lay in bringing them together. I may be taking too much of a naturalist's view of the case, but I must confess that this is exactly my notion of what is to be done with metaphysics and physics. Their differences are complementary, not antagonistic; and thought will never be completely fruitful until the one unites with the other. Let me try to explain what I mean. I hold, with the Materialist, that the human body, like all living bodies, is a machine, all the operations of which will, sooner or later, be explained on physical principles. I believe that we shall, sooner or later, arrive at a mechanical equivalent of consciousness, just as we have arrived at a mechanical equivalent of heat. If a pound weight falling through a distance of a foot gives rise to a definite amount of heat, which may properly be said to be its equivalent; the same pound weight falling through a foot on a man's hand gives rise to a definite amount of feeling, which might with equal propriety be said to be its equivalent in consciousness.[11] And as we already know that there is a certain parity between the intensity of a pain and the strength of one's desire to get rid [192] of that pain; and, secondly, that there is a certain correspondence between the intensity of the heat, or mechanical violence, which gives rise to the pain, and the pain itself; the possibility of the establishment of a correlation between mechanical force and volition becomes apparent. And the same conclusion is suggested by the fact that, within certain limits, the intensity of the mechanical force we exert is proportioned to the intensity of our desire to exert it.

Thus I am prepared to go with the Materialists wherever the true pursuit of the path of Descartes may

lead them; and I am glad, on all occasions, to declare my belief that their fearless development of the materialistic aspect of these matters has had an immense, and a most beneficial, influence upon physiology and psychology. Nay, more, when they go farther than I think they are entitled to do–when they introduce Calvinism into science and declare that man is nothing but a machine, I do not see any particular harm in their doctrines, so long as they admit that which is a matter of experimental fact–namely, that it is a machine capable of adjusting itself within certain limits.

I protest that if some great Power would agree to make me always think what is true and do what is right, on condition of being turned into a sort of clock and wound up every morning before I got out of bed, I should instantly close [193] with the offer. The only freedom I care about is the freedom to do right; the freedom to do wrong I am ready to part with on the cheapest terms to any one who will take it of me. But when the Materialists stray beyond the borders of their path and begin to talk about there being nothing else in the universe but Matter and Force and Necessary Laws, and all the rest of *their* "grenadiers," I decline to follow them. I go back to the point from which we started, and to the other path of Descartes. I remind you that we have already seen clearly and distinctly, and in a manner which admits of no doubt, that all our knowledge is a knowledge of states of consciousness. "Matter" and "Force" are, as far as we can know, mere names for certain forms of consciousness. "Necessary" means that of which we cannot conceive the contrary. "Law" means a rule which we have always found to hold good, and which we expect always will hold good. Thus it is an indisputable truth that what we call the material world is only known to us under the forms of the ideal world; and, as Descartes tells us, our knowledge of the soul[12] is more intimate and certain than our knowledge of the body. If I say that impenetrability is a property of matter, all that I can really mean is that the consciousness I call extension, and the consciousness I call resistance, [194] constantly accompany one another. Why and how they are thus related is a mystery. And if I say that thought is a property of matter, all that I can mean is that actually or possibly, the consciousness of extension and that of resistance accompany all other sorts of consciousness. But, as in the former case, why they are thus associated is an insoluble mystery.

From all this it follows that what I may term legitimate materialism, that is, the extension of the conceptions and of the methods of physical science to the highest as well as the lowest phænomena of vitality, is neither more nor less than a sort of shorthand Idealism; and Descartes' two paths meet at the summit of the mountain, though they set out on opposite sides of it.

The reconciliation of physics and metaphysics lies in the acknowledgment of faults upon both sides; in the confession by physics that all the phænomena of Nature are, in their ultimate analysis, known to us only as facts of consciousness; in the admission by metaphysics, that the facts of consciousness are, practically, interpretable only by the methods and the formulæ of physics: and, finally, in the observance by both metaphysical and physical thinkers of Descartes' maxim–assent to no proposition the matter of which is not so clear and distinct that it cannot be doubted.

[195] When you did me the honour to ask me to deliver this address, I confess I was perplexed what topic to select. For you are emphatically and distinctly a *Christian* body; while science and philosophy,

within the range of which lie all the topics on which I could venture to speak, are neither Christian, nor Unchristian, but are Extra-christian, and have a world of their own, which to use language which will be very familiar to your ears just now, is not only "unsectarian," but is altogether "secular." The arguments which I have put before you tonight, for example, are not inconsistent, so far as I know, with any form of theology.

After much consideration, I thought that I might be most useful to you, if I attempted to give you some vision of this Extra-christian world, as it appears to a person who lives a good deal in it; and if I tried to show you by what methods the dwellers therein try to distinguish truth from falsehood, in regard to some of the deepest and most difficult problems that beset humanity, "in order to be clear about their actions, and to walk surefootedly in this life," as Descartes says.

It struck me that if the execution of my project came anywhere near the conception of it, you would become aware that the philosophers and the men of science are not exactly what they are sometimes represented to you to be; and that their methods and paths do not lead so [196] perpendicularly downwards as you are occasionally told they do. And I must admit, also, that a particular and personal motive weighed with me,–namely, the desire to show that a certain discourse,[13] which brought a great storm about my head some time ago, contained nothing but the ultimate development of the views of the father of modern philosophy. I do not know if I have been quite wise in allowing this last motive to weigh with me. They say that the most dangerous thing one can do in a thunderstorm is to shelter oneself under a great tree, and the history of Descartes' life shows how narrowly he escaped being riven by the lightnings, which were more destructive in his time than in ours.

Descartes lived and died a good Catholic, and prided himself upon having demonstrated the existence of God and of the soul of man. As a reward for his exertions, his old friends the Jesuits put his works upon the "Index," and called him an Atheist; while the Protestant divines of Holland declared him to be both a Jesuit and an Atheist. His books narrowly escaped being burned by the hangman; the fate of Vanini was dangled before his eyes; and the misfortunes of Galileo so alarmed him, that he well-nigh renounced the pursuits by which the world has so greatly benefited, and was driven into subterfuges and evasions which were not worthy of him.

[197] "Very cowardly," you may say; and so it was. But you must make allowance for the fact that, in the seventeenth century, not only did heresy mean possible burning, or imprisonment, but the very suspicion of it destroyed a man's peace, and rendered the calm pursuit of truth difficult or impossible. I fancy that Descartes was a man to care more about being worried and disturbed, than about being burned outright; and, like many other men, sacrificed for the sake of peace and quietness, what he would have stubbornly maintained against downright violence. However this may be, let those who are sure they would have done better throw stones at him. I have no feelings but those of gratitude and reverence for the man who did what he did, when he did; and a sort of shame that any one should repine against taking a fair share of such treatment as the world thought good enough for him.

Finally, it occurs to me that, such being my feeling about the matter, it may be useful to all of us if I ask

you, "What is yours? Do you think that the Christianity of the seventeenth century looks nobler and more attractive for such treatment of such a man?" You will hardly reply that it does. But if it does not, may it not be well if all of you do what lies within your power to prevent the Christianity of the nineteenth century from repeating the scandal?

There are one or two living men, who, a couple [198] of centuries hence, will be remembered as Descartes is now, because they have produced great thoughts which will live and grow as long as mankind lasts.

If the twenty-first century studies their history, it will find that the Christianity of the middle of the nineteenth century recognised them only as objects of vilification. It is for you and such as you, Christian young men, to say whether this shall be as true of the Christianity of the future as it is of that of the present. I appeal to you to say "No," in your own interest, and in that of the Christianity you profess.

In the interest of Science, no appeal is needful; as Dante sings of Fortune–

"Quest' è colei, ch'è tanto posta in croce
Pur da color, cho le dovrian dar lode
Dandole biasmo a torto e mala voce.
Ma ella s' è beata, e ciò non ode:
Con l' altre prime creature lieta
Volve sua spera, e beata si gode: "[14]

so, whatever evil voices may rage, Science, secure among the powers that are eternal, will do her work and be blessed.

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[1] I forget who it was said of him: "Il a plus que personne l'esprit que tout le monde a."

[2] *Discours de la Méthode pour bien conduire sa Raison et chercher la Vérité dans les Sciences.*

[3] "Eine thätige Skepsis ist die, welche unablässig bemüht ist sich selbst zu überwinden, und durch geregelte Erfahrung zu einer Art von bedingter Zuverlässigkeit zu gelangen."–*Maximen und Reflexionen* 7te Abtheilung.

[4] Au milieu ele toutes ses erreurs, il ne faut pas méconnaître une grande idée, qui consiste à avoir tenté pur la première fois de ramener tout les phénomènes naturels à n'être qu'un simple développement des lois de la mécanique," is the weighty judgment of Biot, cited by Bouiller (*Histoire de la Philosophie Cartésienne,* t. i. p. 196).

[5] *Traité de l'Homme* (Cousin's edition), p. 347.

[6] Descartes pretends that he does not apply his views to the human body, but only to an imaginary machine which, if it could be constructed, would do all that the human body does; throwing a sop to Cerberus unworthily; and uselessly, because Cerberus was by no means stupid enough to swallow it.

[7] *Traité de l'Homme*, p. 427.

[8] Compare *Traité des Passions,* Art. xlii. and xvi.

[9] Which, however, as the remains of a Cyclopean eye possesses by some remote ancestor of the *Vertebrata,* has lost none of its interest. [1892.]

[10] Bouillier, into whose excellent *History of the Cartesian Philosophy,* I had not looked when this passage was written says, very justly, that Descartes "a merité le titre de père de la physique, aussi bien que celui de père de la metaphysique moderne" (t. i., p. 197). See also Kuno Fischer's *Geschichte der neuen Philosophie,* Bd. i.; and the very remarkable work of Lange *Geschichte des Materialismus*.–A good translation of the latter would be a great service to philosophy in England. [It now exists, 1892.]

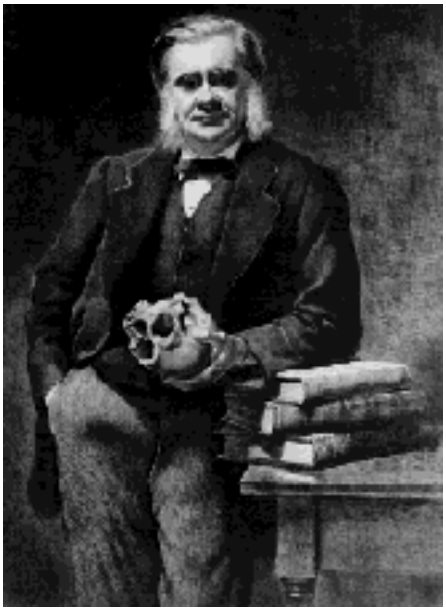
[11] For all the qualifications which need to be made here, I refer the reader to the thorough discussion of the nature of the relation between nerve action and consciousness in Mr. Herbert Spencer's *Principles of Psychology,* p. 115 *et seq.*

[12] Taken as the sum of states of consciousness of the individual. [1892.]

[13] See above, *The Physical Basis of Life.*

[14] "And this is she who's put on cross so much
Even by them who ought to give her praise,
Giving her wrongly ill repute and blame.
But she is blessed, snd she hears not this:
She, with the other primal creatures, glad
Revolves her sphere, and blessed joys herself."
Inferno, vii. 90–96 (W. M. Rossetti's Translation).

THE HUXLEY FILE



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On the Hypothesis that Animals Are Automata, and Its History (1874)

Collected Essays I

[199] The first half of the seventeenth century is one of the great epochs of biological science. For though suggestions and indications of the conceptions which took definite shape, at that time, are to be met with in works of earlier date, they are little more than the shadows which coming truth casts forward; men's knowledge was neither extensive enough, nor exact enough, to show them the solid body of fact which threw these shadows.

But, in the seventeenth century, the idea that the physical processes of life are capable of being explained in the same way as other physical phenomena, and, therefore, that the living body is a mechanism, was proved to be true for certain classes of vital actions; and, having thus taken [200] firm root in irrefragable fact, this conception has not only successfully repelled every assault which has been made upon it, but has steadily grown in force and extent of application, until it is now the expressed or implied fundamental proposition of the whole doctrine of scientific Physiology.

If we ask to whom mankind are indebted for this great service, the general voice will name William Harvey. For, by his discovery of the circulation of the blood in the higher animals, by his explanation of the nature of the mechanism by which that circulation is effected, and by his no less remarkable, though less known, investigations of the process of development, Harvey solidly laid the foundations of all those physical explanations of the functions of sustentation and reproduction which modern physiologists have achieved.

But the living body is not only sustained and reproduced: it adjusts itself to external and internal changes; it moves and feels. The attempt to reduce the endless complexities of animal motion and feeling to law and order is, at least, as important a part of the task of the physiologist as the elucidation of what are sometimes called the vegetative processes. Harvey did not make this attempt himself; but the influence of his work upon the man who did make it is patent and unquestionable. This man was René Descartes, who, though by many years [201] Harvey's junior, died before him; and yet in his short span of fifty-four years, took an undisputed place, not only among the chiefs of philosophy, but amongst the greatest and most original of mathematicians; while, in my belief, he is no less certainly entitled to the rank of a great and original physiologist; inasmuch as he did for the physiology of motion and sensation that which Harvey had done for the circulation of the blood, and opened up that road to the mechanical theory of these processes, which has been followed by all his successors.

Descartes was no mere speculator, as some would have us believe: but a man who knew of his own knowledge what was to be known of the facts of anatomy and physiology in his day. He was an unwearied dissector and observer; and it is said, that, on a visitor once asking to see his library, Descartes led him into a room set aside for dissections, and full of specimens under examination. "There," said he, "is my library."

I anticipate a smile of incredulity when I thus champion Descartes' claim to be considered a physiologist of the first rank. I expect to be told that I have read into his works what I find there, and to be asked, Why is it that we are left to discover Descartes' deserts at this time of day, more than two centuries after his death? How is it that Descartes is utterly ignored in some of [202] the latest works which treat expressly of the subject in which he is said to have been so great?

It is much easier to ask such questions than to answer them, especially if one desires to be on good terms with one's contemporaries; but, if I must give an answer, it is this: The growth of physical science is now so prodigiously rapid, that those who are actively engaged in keeping up with the present, have much ado to find time to look at the past, and even grow into the habit of neglecting it. But, natural as this result may be, it is none the less detrimental. The intellect loses, for there is assuredly no more effectual method of clearing up one's own mind on any subject than by talking it over, so to speak, with men of real power and grasp, who have considered it from a totally different point of view. The parallax of time helps us to the true position of a conception, as the parallax of space helps us to that of a star. And the moral nature loses no less. It is well to turn aside from the fretful stir of the present and to dwell with gratitude and respect upon the services of those "mighty men of old who have gone down to the grave with their weapons of war," but who, while they yet lived, won splendid victories over ignorance. It is well, again, to reflect that the fame of Descartes filled all Europe, and his authority overshadowed it, for a century; while now, most of those who know his name [203] think of him, either as a person who had some preposterous notions about vortices and was deservedly annihilated by the great Sir Isaac Newton; or as the apostle of an essentially vicious method of deductive speculation; and that, nevertheless, neither the chatter of shifting opinion, nor the silence of personal oblivion, has in the slightest degree affected the growth of the great ideas of which he was the instrument and the mouthpiece.

It is a matter of fact that the greatest physiologist of the eighteenth century, Haller, in treating of the functions of nerve, does little more than reproduce and enlarge upon the ideas of Descartes. It is a matter of fact that David Hartley, in his remarkable work the "Essay on Man," expressly, though still insufficiently, acknowledges the resemblance of his fundamental conceptions to those of Descartes; and I shall now endeavour to show that a series of propositions, which constitute the foundation and essence of the modern physiology of the nervous system, are fully expressed and illustrated in the works of Descartes.

> I. *The brain is the organ of sensation, thought, and emotion; that is to say, some change in the condition of the matter of this organ is the invariable antecedent of the state of consciousness to which each of these terms is applied.*

[204] In the "Principes de la Philosophie" (§169), Descartes says:–[1]

"Although the soul is united to the whole body, its principal functions are, nevertheless, performed in the brain; it is here that it not only understands and imagines, but also feels; and this is effected by the intermediation of the nerves, which extend in the form of delicate threads from the brain to all parts of the body, to which they are attached in such a manner, that we can hardly touch any part of the body without setting the extremity of some

nerve in motion. This motion passes along the nerve to that part of the brain which is the common sensorium, as I have sufficiently explained in my 'Treatise on Dioptrics;' and the movements which thus travel along the nerves, as far as that part of the brain with which the soul is closely joined and united, cause it, by reason of their diverse characters, to have different thoughts. And it is these different thoughts of the soul, which arise immediately from the movements that are excited by the nerves in the brain, which we properly term our feelings, or the perceptions of our senses."

Elsewhere,[2] Descartes, in arguing that the seat of the passions is not (as many suppose) the heart, but the brain, uses the following remarkable language:–

"The opinion of those who think that the soul receives its passions in the heart, is of no weight, for it is based upon the fact that the passions cause a change to be felt in that organ; and it is easy to see that this change is felt, as if it were in the [205] heart, only by the intermediation of a little nerve which descends from the brain to it; just as pain is felt, as if it were in the foot, by the intermediation of the nerves of the foot; and the stars are perceived, as if they were in the heavens, by the intermediation of their light and of the optic nerves. So that it is no more necessary for the soul to exert its functions immediately in the heart, to feel its passions there, than it is necessary that it should be in the heavens to see the stars there."

This definite allocation of all the phenomena of consciousness to the brain as their organ, was a step the value of which it is difficult for us to appraise, so completely has Descartes' view incorporated itself with every-day thought and common language. A lunatic ii said to be "crack-brained" or "touched in the head," a confused thinker is "muddle-headed," while a clever man is said to have "plenty of brains"; but it must be remembered that at the end of the last century a considerable, though much over-estimated, anatomist, Bichat, so far from having reached the level of Descartes, could gravely argue that the apparatuses of organic life are the sole seat of the passions, which in no way affect the brain, except so far as it is the agent by which the influence of the passions is transmitted to the muscles.[3]

Modern physiology, aided by pathology, easily demonstrates that the brain is the seat of all forms of consciousness, and fully bears out Descartes' explanation of the reference of those sensations in [206] the viscera which accompany intense emotion, to these organs. It proves, directly, that those states of consciousness which we call sensations are the immediate consequent of a change in the brain excited by the sensory nerves; and, on the well-known effects of injuries, of stimulants, and of narcotics, it bases the conclusion that thought and emotion are, in like manner, the consequents of physical antecedents.

> II. *The movements of animals are due to the change of form of muscles, which shorten and become thicker; and this change of form in a muscle arises from a motion of the substance contained within the nerves which go to the muscle.*

In the "Passions de l'Âme," Art. vii., Descartes writes:–

"Moreover, we know that all the movements of the limbs depend on the muscles, and that these muscles are opposed to one another in such a manner, that when one of them shortens, it draws along the part of the body to which it is attached, and so gives rise to a simultaneous elongation of the muscle which is opposed to it. Then, if

it happens, afterwards, that the latter shortens, it causes the former to elongate, and draws towards itself the part to which it is attached. Lastly, we know that all these movements of the muscles, as all the senses, depend on the nerves, which are like little threads or tubes, which all come from the brain, and, like it, contain a certain very subtle air or wind, termed the animals spirits."

The property of muscle mentioned by Descartes [207] now goes by the general name of contractility, but his definition of it remains untouched. The long-continued controversy whether contractile substance, speaking generally, has an inherent power of contraction, or whether it contracts only in virtue of an influence exerted by nerve, is now settled in Haller's favour; but Descartes' statement of the dependence of muscular contraction on nerve holds good for the higher forms of muscle, under normal circumstances; so that, although the structure of the various modifications of contractile matter has been worked out with astonishing minuteness–although the delicate physical and chemical changes which accompany muscular contraction have been determined to an extent of which Descartes could not have dreamed, and have quite upset his hypothesis that the cause of the shortening and thickening of the muscle is the flow of animal spirits into it from the nerves–the important and fundamental part of his statement remains perfectly true.

The like may be affirmed of what he says about nerve. We know now that nerves are not exactly tubes, and that "animal spirits" are myths; but the exquisitely refined methods of investigation of Dubois-Reymond and of Helmholz have no less clearly proved that the antecedent of ordinary muscular contraction is a motion of the molecules of the nerve going to the muscle; and that this motion is propagated with a measurable, and by [208] no means great, velocity, through the substance of the nerve towards the muscle.

With the progress of research, the term "animal spirits" gave way to "nervous fluid," and "nervous fluid" has now given way to "molecular motion of nerve-substance." Our conceptions of what takes place in nerve have altered in the same way as our conceptions of what takes place in a conducting wire have altered, since electricity was shown to be not a fluid, but a mode of molecular motion. The change is of vast importance, but it does not affect Descartes' fundamental idea, that a change in the substance of a motor nerve propagated towards a muscle is the ordinary cause of muscular contraction

> III. *The sensations of animals are due to a motion of the substance of the nerves which connect the sensory organs with the brain.*

In "La Dioptrique" (Discours Quatrième), Descartes explains, more fully than in the passage cited above, his hypothesis of the mode of action of sensory nerves:–

"It is the little threads of which the inner substance of the nerves is composed which subserve sensation. You must conceive that these little threads, being inclosed in tubes, which are always distended and kept open by the animal spirits which they contain, neither press upon nor interfere with one another and are extended from the brain to the extremities of all the mem[209]bers which are sensitive–in such a manner, that the slightest touch which excites the part of one of the members to which a thread is attached, gives rise to a motion of the part of the brain whence it arises, just as by pulling one of the ends of a stretched cord, the other end is simultaneously

moved. . . . And we must take care not to imagine that, in order to feel, the soul needs to behold certain images sent by the objects of sense to the brain, as our philosophers commonly suppose; or, at least, we must conceive these images to be something quite different form what they suppose them to be. For, as all they suppose is that these images ought to resemble the objects which they represent, it is impossible for them to show how they can be formed by the objects received by the organs of the external senses and transmitted to the brain. And they have had no reason for supposing the existence of these images except this; seeing that the mind is readily excited by a picture to conceive the object which is depicted, they have thought that it must be excited in the same way to conceive those objects which affect our senses by little pictures of them formed in the head; instead of which we ought to recollect that there are many things besides images which may excite the mind, as, for example, signs and words, which have not the least resemblance to the objects which they signify."[4]

Modern physiology amends Descartes' conception of the mode of action of sensory nerves in detail, by showing that their structure is the same as that of motor nerves; and that the changes which take place in them, when the sensory organs with which they are connected are excited, are of [210] just the same nature as those which occur in motor nerves, when the muscles to which they are distributed are made to contract: there is a molecular change which, in the case of the sensory nerve, is propagated towards the brain. But the great fact insisted upon by Descartes, that no likeness of external things is, or can be, transmitted to the mind by the sensory organs; on the contrary, that, between the external cause of a sensation and the sensation, there is interposed a mode of motion of nervous matter, of which the state of consciousness is no likeness, but a mere symbol, is of the profoundest importance. It is the physiological foundation of the doctrine of the relativity of knowledge, and a more or less complete idealism is a necessary consequence of it.

For of two alternatives one must be true. Either consciousness is the function of a something distinct from the brain, which we call the soul, and a sensation is the mode in which this soul is affected by the motion of a part of the brain; or there is no soul, and a sensation is something generated by the mode of motion of a part of the brain. In the former case, the phenomena of the senses are purely spiritual affections; in the latter, they are something manufactured by the mechanism of the body, and as unlike the causes which set that mechanism in motion, as the sound of a repeater is unlike the pushing of the spring which gives rise to it.

[211] The nervous system stands between consciousness and the assumed external world, as an interpreter who can talk with his fingers stands between a hidden speaker and a man who is stone deaf–and Realism is equivalent to a belief on the part of the deaf man, that the speaker must also be talking with his fingers. "Les extrêmes se touchent;" the shibboleth of materialists that "thought is a secretion of the brain," is the Fichtean doctrine that "the phenomenal universe is the creation of the Ego," expressed in other language.

> IV. *The motion of the matter of a sensory nerve may be transmitted through the brain to motor nerves, and thereby give rise to contraction of the muscles to which these motor nerves are distributed; and this reflection of motion from a sensory into a motor nerve may take place without volition, or even contrary to it.*

In stating these important truths, Descartes defined that which we now term "reflex action." Indeed he almost uses the term itself, as he talks of the "animal spirits" as "réfléchis,"[5] from the sensory into the motor nerves. And that this use of the word "reflected" was no mere accident, but that the importance and appropriateness [212] of the idea it suggests was fully understood by Descartes' contemporaries, is apparent from a passage in Willis's well-known essay, "De Animâ Brutorum," published in 1672, in which, in giving an account of Descartes' views, he speaks of the animal spirits being diverted into motor channels, "velut undulatione reflexâ."[6]

Nothing can be clearer in statement, or in illustration, than the view of reflex action which Descartes gives in the "Passions de l'Âme," Art. xiii.

After recapitulating the manner in which sensory impressions transmitted by the sensory nerves to the brain give rise to sensation, he proceeds:–

"And in addition to the different feelings excited in the soul by these different motions of the brain, the animals spirits, without the intervention of the soul, may take their course towards certain muscles, rather than towards others, and thus move the limbs, as I shall prove by an example. If someone moves his hand rapidly towards our eyes, as if he were going to strike us, although we know that he is a friend, that he does it only in just, and that he will be very careful to do us no harm, nevertheless it will be hard to keep from winking. And this shows, that it is not by the agency of the soul that the eyes shut, since this action is contrary to that volition which is the [213] only, or at least the chief, function of the soul; but it is because the mechanism of our body is so disposed, that the motion of the hand towards our eyes excites another movement in our brain, and this sends the animal spirits into those muscles which cause the eyelids to close."

Since Descartes' time, experiment has eminently enlarged our knowledge of the details of reflex action. The discovery of Bell has enabled us to follow the tracks of the sensory and motor impulses, along distinct bundles of nerve fibres; and the spinal cord, apart from the brain, has been proved to be a great centre of reflex action; but the fundamental conception remains as Descartes left it, and it is one of the pillars of nerve physiology at the present day.

> V. *The motion of any given portion of the matter of the brain excited by the motion of a sensory nerve, leaves behind a readiness to be moved in the same way, in that part. Anything which resuscitates the motion gives rise to the appropriate feeling. This is the physical mechanism of memory.*

Descartes imagined that the pineal body (a curious appendage to the upper side of the brain, the function of which, if it have any, is wholly unknown)[7] was the instrument through which the soul received impressions from, and communicated them to, the brain. And he thus endeavours to [214] explain what happens when one tries to recollect something:–

"Thus when the soul wills to remember anything, this volition, causing the [pineal] gland to incline itself in different directions, drives the [animal] spirits towards different regions of the brain, until they reach that part in

which are the traces, which the object which it desires to remember has left. These traces are produced thus: those pores of the brain through which the [animal] spirits have previously been driven, by reason of the presence of the object, have thereby acquired a tendency to be opened by the animal spirits which return towards them more readily than other pores, so that the animal spirits, impinging on these pores, enter them more readily than others. By this means they excite a particular movement in the pineal gland, which represents the object to the soul, and causes it to know what it is which it desired to recollect."[8]

That memory is dependent upon some condition of the brain is a fact established by many considerations–among the most important of which are the remarkable phenomena of aphasia. And that the condition of the brain on which memory depends, is largely determined by the repeated occurrence of that condition of its molecules, which gives rise to the idea of the thing remembered, is no less certain. Every boy who learns his lesson by repeating it exemplifies the fact. Descartes, as we have seen, supposes that the pores of a given part of the brain are stretched by the animal spirits, on the occurrence of a sensation, and that the part of the brain thus stretched, [215] being imperfectly elastic, does not return to exactly its previous condition, but remains more distensible than it was before. Hartley supposes that the vibrations, excited by a sensory, or other, impression, do not die away, but are represented by smaller vibrations or "vibratiuncules," the permanency and intensity of which are in relation with the frequency of repetition of the primary vibrations. Haller has substantially the same idea, but contents himself with the general term "mutationes," to express the cerebral change which is the cause of a state of consciousness. These "mutationes" persist for a long time after the cause which gives rise to them has ceased to operate, and are arranged in the brain according to the order of coexistence and succession of their causes. And he gives these persistent "mutationes" the picturesque name of *vestigia rerum,* "quæ non in mente sed in ipso corpore et in medulla quidem cerebri ineffabili modo incredibiliter minutis notis et copia infinita, inscriptæ sunt."[9] I do not know that any modern theory of the physical conditions of memory differs essentially from these, which are all children–*mutatis mutandis*–of the Cartesian doctrine. Physiology is, at present, incompetent to say anything positively about the matter, or to go farther than the expression of the high probability, that every molecular change which gives rise to a state of [216] consciousness, leaves a more or less persistent structural modification, through which the same molecular change may be regenerated by other agencies than the cause which first produced it.

Thus far, the prepositions respecting the physiology of the nervous system which are stated by Descartes have simply been more clearly defined, more fully illustrated, and, for the most part, demonstrated, by modern physiological research. But there remains a doctrine to which Descartes attached great weight, so that full acceptance of it became a sort of note of a thoroughgoing Cartesian, but which, nevertheless, is so opposed to ordinary prepossessions that it attained more general notoriety, and gave rise to more discussion, than almost any other Cartesian hypothesis. It is the doctrine that brute animals are mere machines or automata, devoid not only of reason, but of any kind of consciousness, which is stated briefly in the "Discours de la Méthode," and more fully in the "Réponses aux Quatrièmes Objections," and in the correspondence with Henry More.[10]

The process of reasoning by which Descartes arrived at this startling conclusion is well shown in the

following passage of the "Réponses:"–

"But as regards the souls of beasts, although this is not the place for considering them, and though, without a general [217] exposition of physics, I can say no more on this subject than I have already said in the fifth part of my Treatise on Method; yet, I will further state, here, that it appears to me to be a very remarkable circumstance that no movement can take place, either in the bodies of beasts, or even in our own, if these bodies have not in themselves all the organs and instruments by means of which the very same movements would be accomplished in a machine. So that, even in us, the spirit, or the soul, does not directly move the limbs, but only determines the course of that very subtle liquid which is called the animal spirits, which, running continually from the heart by the brain into the muscles, is the cause of all the movements of our limbs, and often may cause many different motions, one as easily as the other.

"And it does not even always exert this determination; for among the movements which take place in us, there are many which do not depend on the mind at all, such as the beating of the heart, the digestion of food, the nutrition, the respiration of those who sleep; and even in those who are awake, walking, singing, and other similar actions, when they are performed without the mind thinking about them. And, when one who falls from a height throws his hands forward to save his head, it is in virtue of no ratiocination that he performs this action; it does not depend upon his mind, but takes place merely because his senses being affected by the present danger, some change arises in his brain which determines the animal spirits to pass thence into the nerves, in such a manner as is required to produce this motion, in the same way as in a machine, and without the mind being able to hinder it. Now since we observe this in ourselves, why should we be so much astonished if the light reflected from the body of a wolf into the eye of a sheep has the same force to excite in it the motion of flight?

"After having observed this, if we wish to learn by reasoning, whether certain movements of beasts are comparable to those which are effected in us by the operation of the mind, or, on the contrary, to those which depend only on the animal spirits and the disposition of the organs, it is necessary to consider the difference between the two, which I have explained in the fifth part of the Discourse on Method (for I do not think that any [218] others are discoverable), and then it will easily be seen, that all the actions of beasts are similar only to those which we perform without the help of our minds. For which reason we shall be forced to conclude, that we know of the existence in them of no other principle of motion than the disposition of their organs and the continual affluence of animal spirits produced by the heat of the heart, which attenuates and subtilises the blood; and, at the same time, we shall acknowledge that we have had no reason for assuming any other principle, except that, not having distinguished these two principles of motion, and seeing that the one, which depends only on the animal spirits and the organs, exists in beasts as well as in us, we have hastily concluded that the other, which depends on mind and on thought, was also possessed by them."

Descartes' line of argument is perfectly clear. He starts from reflex action in man, from the unquestionable fact that, in ourselves, co-ordinate, purposive, actions may take place, without the intervention of consciousness or volition, or even contrary to the latter. As actions of a certain degree of complexity are brought about by mere mechanism, why may not actions of still greater complexity be the result of a more refined mechanism? What proof is there that brutes are other than a superior race of marionettes, which eat without pleasure, cry without pain, desire nothing, know nothing, and only simulate intelligence as a bee simulates a mathematician?[11]

The Port Royalists adopted the hypothesis that [219] brutes are machines, and are said to have carried its

practical applications so far as to treat domestic animals with neglect, if not with actual cruelty. As late as the middle of the eighteenth century, the problem was discussed very fully and ably by Bouillier, in his "Essai philosophique sur 1'Ame des Bêtes," while Condillac deals with it in his "Traite des Animaux;" but since then it has received little attention. Nevertheless, modern research has brought to light a great multitude of facts, which not only show that Descartes' view is defensible, but render it far more defensible than it was in his day.

It must be premised, that it is wholly impossible absolutely to prove the presence or absence of consciousness in anything but one's own brain, though, by analogy, we are justified in assuming its existence in other men. Now if, by some accident, a man's spinal cord is divided, his limbs are paralysed, so far as his volition is concerned, below the point of injury; and he is incapable of experiencing all those states of consciousness which, in his uninjured state, would be excited by irritation of those nerves which come off below the injury. If the spinal cord is divided in the [220] middle of the back, for example, the skin of the feet may be cut, or pinched, or burned, or wetted with vitriol, without any sensation of touch, or of pain, arising in consciousness. So far as the man is concerned, therefore, the part of the central nervous system which lies beyond the injury is cut off from consciousness. It must indeed be admitted, that, if any one think fit to maintain that the spinal cord below the injury is conscious, but that it is cut off from any means of making its consciousness known to the other consciousness in the brain, there is no means of driving him from his position by logic. But assuredly there is no way of proving it, and in the matter of consciousness, if in anything, we may hold by the rule, "De non apparentibus et de non existentibus eadem est ratio." However near the brain the spinal cord is injured, consciousness remains intact, except that the irritation of parts below the injury is no longer represented by sensation. On the other hand, pressure upon the anterior division of the brain, or extensive injuries to it, abolish consciousness. Hence, it is a highly probable conclusion, that consciousness in man depends upon the integrity of the anterior division of the brain, while the middle and hinder divisions of the brain,[12] and the rest of the nervous centres, have nothing to do with it. And it is further highly probable, [221] that what is true for man is true for other vertebrated animals.

We may assume, then, that in a living vertebrated animal, any segment of the cerebro-spinal axis (or spinal cord and brain) separated from that anterior division of the brain which is the organ of consciousness, is as completely incapable of giving rise to consciousness as we know it to be incapable of carrying out volitions. Nevertheless, this separated segment of the spinal cord is not passive and inert. On the contrary, it is the seat of extremely remarkable powers. In our imaginary case of injury, the man would, as we have seen, be devoid of sensation in his legs, and would have not the least power of moving them. But, if the soles of his feet were tickled, the legs would be drawn up just as vigorously as they would have been before the injury. We know exactly what happens when the soles of the feet are tickled; a molecular change takes place in the sensory nerves of the skin, and is propagated along them and through the posterior roots of the spinal nerves, which are constituted by them, to the grey matter of the spinal cord. Through that grey matter the molecular motion is reflected into the anterior roots of the same nerves, constituted by the filaments which supply the muscles of the legs, and, travelling along these motor filaments, reaches the muscles, which at once contract, and cause the limbs to be drawn up.

[222] In order to move the legs in this way, a definite co-ordination of muscular contractions is necessary; the muscles must contract in a certain order and with duly proportioned force; and moreover, as the feet are drawn away from the source of irritation, it may be said that the action has a final cause, or is purposive.

Thus it follows, that the grey matter of the segment of the man's spinal cord, though it is devoid of consciousness, nevertheless responds to a simple stimulus by giving rise to a complex set of muscular contractions, co-ordinated towards a definite end, and serving an obvious purpose.

If the spinal cord of a frog is cut across, so as to provide us with a segment separated from the brain, we shall have a subject parallel to the injured man, on which experiments can be made without remorse; as we have a right to conclude that a frog's spinal cord is not likely to be conscious, when a man's is not.

Now the frog behaves just as the man did. The legs are utterly paralysed, so far as voluntary movement is concerned; but they are vigorously drawn up to the body when any irritant is applied to the foot. But let us study our frog a little farther. Touch the skin of the side of the body with a little acetic acid, which gives rise to all the signs of great pain in an uninjured frog. In this case, there can be no pain, because the application is made to a part of the skin supplied with [223] nerves which come off from the cord below the point of section; nevertheless, the frog lifts up the limb of the same side, and applies the foot to rub off the acetic acid; and, what is still more remarkable, if the limb be held so that the frog cannot use it, it will, by and by, move the limb of the other side, turn it across the body, and use it for the same rubbing process. It is impossible that the frog, if it were in its entirety and could reason, should perform actions more purposive than these: and yet we have most complete assurance that, in this case, the frog is not acting from purpose, has no consciousness, and is a mere insensible machine.

But now suppose that, instead of making a section of the cord in the middle of the body, it had been made in such a manner as to separate the hindermost division of the brain from the rest of the organ, and suppose the foremost two-thirds of the brain entirely taken away. The frog is then absolutely devoid of any spontaneity; it sits upright in the attitude which a frog habitually assumes; and it will not stir unless it is touched; but it differs from the frog which I have just described in this, that, if it be thrown into the water, it begins to swim, and swims just as well as the perfect frog does. But swimming requires the combination and successive co-ordination of a great number of muscular actions. And we are forced to conclude, that the impression [224] made upon the sensory nerves of the skin of the frog by the contact with the water into which it is thrown, causes the transmission to the central nervous apparatus of an impulse which sets going a certain machinery by which all the muscles of swimming are brought into play in due co-ordination. If the frog be stimulated by some irritating body, it jumps or walks as well as the complete frog can do. The simple sensory impression, acting through the machinery of the cord, gives rise to these complex combined movements.

It is possible to go a step farther. Suppose that only the anterior division of the brain–so much of it as lies in front of the "optic lobes"–is removed. If that operation is performed quickly and skilfully, the frog may be kept in a state of full bodily vigour for months, or it may be for years; but it will sit unmoved. It

sees nothing: it hears nothing. It will starve sooner than feed itself, although food put into its mouth is swallowed. On irritation, it jumps or walks; if thrown into the water it swims. If it be put on the hand, it sits there, crouched, perfectly quiet, and would sit there for ever. If the hand be inclined very gently and slowly, so that the frog would naturally tend to slip off, the creature's fore paws are shifted on to the edge of the hand, until he can just prevent himself from falling. If the turning of the hand be slowly continued, he [225] mounts up with great care and deliberation, putting first one leg forward and then another, until he balances himself with perfect precision upon the edge; and if the turning of the hand is continued, he goes through the needful set of muscular operations, until he comes to be seated in security, upon the back of the hand. The doing of all this requires a delicacy of coordination, and a precision of adjustment of the muscular apparatus of the body, which are only comparable to those of a rope-dancer. To the ordinary influences of light, the frog, deprived of its cerebral hemispheres, appears to be blind. Nevertheless, if the animal be put upon a table, with a book at some little distance between it and the light, and the skin of the hinder part of its body is then irritated, it will jump forward, avoiding the book by passing to the right or left of it. Therefore, although the frog appears to have no sensation of light, visible objects act through its brain upon the motor mechanism of its body.[13]

It is obvious, that had Descartes been acquainted with these remarkable results of modern research, they would have furnished him with far more powerful arguments than he possessed in favour of his view of the automatism of brutes. The [226] habits of a frog, leading its natural life, involve such simple adaptations to surrounding conditions, that the machinery which is competent to do so much without the intervention of consciousness, might well do all. And this argument is vastly strengthened by what has been learned in recent times of the marvellously complex operations which are performed mechanically, and to all appearance without consciousness, by men, when, in consequence of injury or disease, they are reduced to a condition more or less comparable to that of a frog, in which the anterior part of the brain has been removed. A case has recently been published by an eminent French physician, Dr. Mesnet, which illustrates this condition so remarkably, that I make no apology for dwelling upon it at considerable length.[14]

A sergeant of the French army, F—, twenty-seven years of age, was wounded during the battle of Bazeilles, by a ball which fractured his left parietal bone. He ran his bayonet through the Prussian soldier who wounded him, but almost immediately his right arm became paralysed; after walking about two hundred yards, his right leg became similarly affected, and he lost his senses. When he recovered them, three weeks [227] afterwards, in hospital at Mayence, the right half of the body was completely paralysed, and remained in this condition for a year. At present, the only trace of the paralysis which remains is a slight weakness of the right half of the body. Three or four months after the wound was inflicted, periodical disturbances of the functions of the brain made their appearance, and have continued ever since. The disturbances last from fifteen to thirty hours; the intervals at which they occur being from fifteen to thirty days.

For four years, therefore, the life of this man has been divided into alternating phases–short abnormal states intervening between long normal states.

In the periods of normal life, the ex-sergeant's health is perfect; he is intelligent and kindly, and performs, satisfactorily, the duties of a hospital attendant. The commencement of the abnormal state is ushered in by uneasiness and a sense of weight about the forehead, which the patient compares to the constriction of a circle of iron; and, after its termination, he complains, for some hours, of dulness and heaviness of the head. But the transition from the normal to the abnormal state takes place in a few minutes, without convulsions or cries, and without anything to indicate the change to a bystander. His movements remain free and his expression calm, except for a [228] contraction of the brow, an incessant movement of the eyeballs, and a chewing motion of the jaws. The eyes are wide open, and their pupils dilated. If the man happens to be in a place to which he is accustomed, he walks about as usual; but, if he is in a new place, or if obstacles are intentionally placed in his way, he stumbles gently against them, stops, and then, feeling over the objects with his hands, passes on one side of them. He offers no resistance to any change of direction which may be impressed upon him, or to the forcible acceleration or retardation of his movements. He eats, drinks, smokes, walks about, dresses and undresses himself, rises and goes to bed at the accustomed hours. Nevertheless, pins may be run into his body, or strong electric shocks sent through it, without causing the least indication of pain; no odorous substance, pleasant or unpleasant, makes the least impression; he eats and drinks with avidity whatever is offered, and takes asafœtida, or vinegar, or quinine, as readily as water; no noise affects him; and light influences him only under certain conditions. Dr. Mesnet remarks, that the sense of touch alone seems to persist, and indeed to be more acute and delicate than in the normal state: and it is by means of the nerves of touch, almost exclusively, that his organism is brought into relation with the external world. Here a difficulty arises. It is clear from the facts detailed, that the nervous apparatus by [229] which, in the normal state, sensations of touch are excited, is that by which external influences determine the movements of the body, in the abnormal state. But does the state of consciousness, which we term a tactile sensation, accompany the operation of this nervous apparatus in the abnormal state? or is consciousness utterly absent, the man being reduced to an insensible mechanism?

It is impossible to obtain direct evidence in favour of the one conclusion or the other; all that can be said is, that the case of the frog shows that the man may be devoid of any kind of consciousness.

A further difficult problem is this. The man is insensible to sensory impressions made through the ear, the nose, the tongue, and, to a great extent, the eye; nor is he susceptible of pain from causes operating during his abnormal state. Nevertheless, it is possible so to act upon his tactile apparatus, as to give rise to those molecular changes in his sensorium, which are ordinarily the causes of associated trains of ideas. I give a striking example of this process in Dr. Mesnet's words:–

"Il se promenait dans le jardin, sous un massif d'arbres, on lui remet à la main sa canne qu'il avait laisse tomber quelques minutes avant. Il la palpe, promène a plusieurs reprises la main sur la poignée coudée de sa canne–devient attentif–semble préter l'oreille–et, tout-à-coup, appelle 'Henri!' Puis, 'Les voilà? Ils sont au moins une vingtaine! à nous deux, nous en [230] viendrons à bout!' Et alors portant la main derrière son dos comme pour prendre une cartouche, il fait le mouvement de charger son arme, se couche dans l'herbe à plat ventre, la téte cachée par un arbre, dans la position d'un tirailleur, et suit l'arme épaulée, tous les mouvements de l'ennemi qu'il croit voir à courte distance."

In a subsequent abnormal period, Dr. Mesnet caused the patient to repeat this scene by placing him in the same conditions. Now, in this case, the question arises whether the series of actions constituting this singular pantomime was accompanied by the ordinary states of consciousness, the appropriate train of ideas, or not? Did the man dream that he was skirmishing? or was he in the condition of one of Vaucauson's automata–a senseless mechanism worked by molecular changes in his nervous system? The analogy of the frog shows that the latter assumption is perfectly justifiable.

The ex-sergeant has a good voice, and had, at one time, been employed as a singer at a cafe. In one of his abnormal states he was observed to begin humming a. tune. He then went to his room, dressed himself carefully, and took up some parts of a periodical novel, which lay on his bed, as if he were trying to find something. Dr. Mesnet, suspecting that he was seeking his music, made up one of these into a roll and put it into his hand. He appeared satisfied, took his cane and went down stairs to the door. Here Dr. Mesnet turned him round, and he walked [231] quite contentedly, in the opposite direction, towards the room of the concierge. The light of the sun shining through a window now happened to fall upon him, and seemed to suggest the footlights of the stage on which he was accustomed to make his appearance. He stopped, opened his roll of imaginary music, put himself into the attitude of a singer, and sang, with perfect execution, three songs, one after the other. After which he wiped his face with his handkerchief and drank, without a grimace, a tumbler of strong vinegar and water which was put into his hand.

An experiment which may be performed upon the frog deprived of the fore part of its brain, well known as Göltz's "Quak-versuch," affords a parallel to this performance. If the skin of a certain part of the back of such a frog is gently stroked with the finger, it immediately croaks. It never croaks unless it is so stroked, and the croak always follows the stroke, just as the sound of a repeater follows the touching of the spring. In the frog, this "song" is innate–so to speak *a priori*–and depends upon a mechanism in the brain governing the vocal apparatus, which is set at work by the molecular change set up in the sensory nerves of the skin of the back by the contact of a foreign body.

In man there is also a vocal mechanism, and the cry of an infant is in the same sense innate and *a priori,* inasmuch as it depends on an organic [232] relation between its sensory nerves and the nervous mechanism which governs the vocal apparatus. Learning to speak, and learning to sing, are processes by which the vocal mechanism is set to new tunes. A song which has been learned has its molecular equivalent, which potentially represents it in the brain, just as a musical box, wound up, potentially represents an overture. Touch the stop and the overture begins; send a molecular impulse along the proper afferent nerve and the singer begins his song.

Again, the manner in which the frog, though apparently insensible to light, is yet, under some circumstances, influenced by visual images, finds a singular parallel in the case of the ex-sergeant.

Sitting at a table, in one of his abnormal states, he took up a pen, felt for paper and ink, and began to write a letter to his general, in which he recommended himself for a medal, on account of his good conduct and courage. It occurred to Dr. Mesnet to ascertain experimentally how far vision was

concerned in this act of writing. He therefore interposed a screen between the man's eyes and his hands; under these circumstances he went on writing for a short time, but the words became illegible, and he finally stopped, without manifesting any discontent. On the withdrawal of the screen he began to write again where he had left off. The substitution of water for ink in the inkstand had a similar result. He stopped, [233] looked at his pen, wiped it on his coat, dipped it in the water, and began again with the same effect.

On one occasion, he began to write upon the topmost of ten superimposed sheets of paper. After he had written a line or two, this sheet was suddenly drawn away. There was a slight expression of surprise, but he continued his letter on the second sheet exactly as if it had been the first. This operation was repeated five times, so that the fifth sheet contained nothing but the writer's signature at the bottom of the page. Nevertheless, when the signature was finished, his eyes turned to the top of the blank sheet, and he went through the form of reading over what he had written, a movement of the lips accompanying each word; moreover, with his pen, he put in such corrections as were needed, in that part of the blank page which corresponded with the position of the words which required correction, in the sheets which had been taken away. If the five sheets had been transparent, therefore, they would, when superposed, have formed a properly written and corrected letter.

Immediately after he had written his letter, F—got up, walked down to the garden, made himself a cigarette, lighted and smoked it. He was about to prepare another, but sought in vain for his tobacco-pouch, which had been purposely taken away. The pouch was now thrust before his eyes and put under his nose, but he neither [234] saw nor smelt it; yet, when it was placed in his hand, he at once seized it, made a fresh cigarette, and ignited a match to light the latter. The match was blown out, and another lighted match placed close before his eyes, but he made no attempt to take it; and, if his cigarette was lighted for him, he made no attempt to smoke. All this time the eyes were vacant, and neither winked, nor exhibited any contraction of the pupils. From these and other experiments, Dr. Mesnet draws the conclusion that his patient sees some things and not others; that the sense of sight is accessible to all things which are brought into relation with him by the sense of touch, and, on the contrary, insensible to things which lie outside this relation. He sees the match he holds and does not see any other.

Just so the frog "sees" the book which is in the way of his jump, at the same time that isolated visual impressions take no effect upon him.[15]

[235] As I have pointed out, it is impossible to prove that F-–is absolutely unconscious in his abnormal state, but it is no less impossible to prove the contrary; and the case of the frog goes a long way to justify the assumption that, in the abnormal state, the man is a mere insensible machine.

If such facts as these had come under the knowledge of Descartes, would they not have formed an apt commentary upon that remarkable passage in the "Traité de l'Homme," which I have quoted elsewhere, but which is worth repetition?–

"All the functions which I have attributed to this machine (the body), as the digestion of food, the pulsation of the

heart and of the arteries; the nutrition and the growth of the limbs; respiration, wakefulness, and sleep; the reception of light, sounds, odours, flavours, heat, and such like qualities, in the organs of the external senses; the impression of the ideas of these in the organ of common sensation and in the imagination; [236] the retention or the impression of these ideas on the memory; the internal movements of the appetites and the passions; and lastly the external movements of all the limbs, which follow so aptly, as well the action of the objects which are presented to the senses, as the impressions which meet in the memory, that they imitate as nearly as possible those of a real man; I desire, I say, that you should consider that these functions in the machine naturally proceed from the mere arrangement of its organs, neither more nor less than do the movements of a clock, or other automaton, from that of its weights and its wheels; so that, so far as these are concerned, it is not necessary to conceive any other vegetative or sensitive soul, nor any other principle of motion or of life, than the blood and the spirits agitated by the fire which burns continually in the heart, and which is no wise essentially different from all the fires which exist in inanimate bodies."

And would Descartes not have been justified in asking why we need deny that animals are machines, when men, in a state of unconsciousness, perform, mechanically, actions as complicated and as seemingly rational as those of any animals?

But though I do not think that Descartes' hypothesis can be positively refuted, I am not disposed to accept it. The doctrine of continuity is too well established for it to be permissible to me to suppose that any complex natural phenomenon comes into existence suddenly, and without being preceded by simpler modifications; and very strong arguments would be needed to prove that such complex phenomena as those of consciousness, first make their appearance in man. We know, that, in the individual man, consciousness grows from a dim glimmer to its full light, whether [237] we consider the infant advancing in years, or the adult emerging from slumber and swoon. We know, further, that the lower animals possess, though less developed, that part of the brain which we have every reason to believe to be the organ of consciousness in man; and as, in other cases, function and organ are proportional, so we have a right to conclude it is with the brain; and that the brutes, though they may not possess our intensity of consciousness, and though, from the absence of language, they can have no trains of thoughts, but only trains of feelings, yet have a consciousness which, more or less distinctly, foreshadows our own.

I confess that, in view of the struggle for existence which goes on in the animal world, and of the frightful quantity of pain with which it must be accompanied, I should be glad if the probabilities were in favour of Descartes' hypothesis; but, on the other hand, considering the terrible practical consequences to domestic animals which might ensue from any error on our part, it is as well to err on the right side, if we err at all, and deal with them as weaker brethren, who are bound, like the rest of us, to pay their toll for living, and suffer what is needful for the general good. As Hartley finely says, "We seem to be in the place of God to them;" and we may justly follow the precedents He sets in nature in our dealings with them.

But though we may see reason to disagree with [238] Descartes' hypothesis that brutes are unconscious machines, it does not follow that he was wrong in regarding them as automata. They may be more or less conscious, sensitive, automata; and the view that they are such conscious machines is that which is implicitly, or explicitly, adopted by most persons. When we speak of the actions of the lower animals

being guided by instinct and not by reason, what we really mean is that, though they feel as we do, yet their actions are the results of their physical organisation. We believe, in short, that they are machines, one part of which (the nervous system) not only sets the rest in motion, and co-ordinates its movements in relation with changes in surrounding bodies, but is provided with special apparatus, the function of which is the calling into existence of those states of consciousness which are termed sensations, emotions, and ideas. I believe that this generally accepted view is the best expression of the facts at present known.

It is experimentally demonstrable–any one who cares to run a pin into himself may perform a sufficient demonstration of the fact–that a mode of motion of the nervous system is the immediate antecedent of a state of consciousness. All but the adherents of "Occasionalism," or of the doctrine of "Pre-established Harmony" (if any such now exist), must admit that we have as much reason for regarding the mode of motion of the [239] nervous system as the cause of the state of consciousness, as we have for regarding any event as the cause of another. How the one phenomenon causes the other we know, as much or as little, as in any other case of causation; but we have as much right to believe that the sensation is an effect of the molecular change, as we have to believe that motion is an effect of impact; and there is as much propriety in saying that the brain evolves sensation, as there is in saying that an iron rod, when hammered, evolves heat.

As I have endeavoured to show, we are justified in supposing that something analogous to what happens in ourselves takes place in the brutes, and that the affections of their sensory nerves give rise to molecular changes in the brain, which again give rise to, or evolve, the corresponding states of consciousness. Nor can there be any reasonable doubt that the emotions of brutes, and such ideas as they possess, are similarly dependent upon molecular brain changes. Each sensory impression leaves behind a record in the structure of the brain–an "ideagenous" molecule, so to speak, which is competent, under certain conditions, to reproduce, in a fainter condition, the state of consciousness which corresponds with that sensory impression; and it is these "ideagenous molecules" which are the physical basis of memory.

It may be assumed, then, that molecular changes in the brain are the causes of all the [240] states of consciousness of brutes. Is there any evidence that these states of consciousness may, conversely, cause those molecular changes which give rise to muscular motion? I see no such evidence. The frog walks, hops, swims, and goes through his gymnastic performances quite as well without consciousness, and consequently without volition, as with it; and, if a frog, in his natural state, possesses anything corresponding with what we call volition, there is no reason to think that it is anything but a concomitant of the molecular changes in the brain which form part of the series involved in the production of motion.

The consciousness of brutes would appear to be related to the mechanism of their body simply as a collateral product of its working, and to be as completely without any power of modifying that working as the steam-whistle which accompanies the work of a locomotive engine is without influence upon its machinery. Their volition, if they have any, is an emotion indicative of physical changes, not a cause of such changes.

This conception of the relations of states of consciousness with molecular changes in the brain–of *psychoses* with *neuroses*–does not prevent us from ascribing free will to brutes. For an agent is free when there is nothing to prevent him from doing that which he desires to do. If a greyhound chases a hare, he is a free agent, because his action is in entire accordance with his strong [241] desire to catch the hare; while so long as he is held back by the leash he is not free, being prevented by external force from following his inclination. And the ascription of freedom to the greyhound under the former circumstances is by no means inconsistent with the other aspect of the facts of the case–that he is a machine impelled to the chase, and caused, at the same time, to have the desire to catch the game by the impression which the rays of light proceeding from the hare make upon his eyes, and through them upon his brain.

Much ingenious argument has at various times been bestowed upon the question: How is it possible to imagine that volition, which is a state of consciousness, and, as such, has not the slightest community of nature with matter in motion, can act upon the moving matter of which the body is composed, as it is assumed to do in voluntary acts? But if, as is here suggested, the voluntary acts of brutes–or, in other words, the acts which they desire to perform–are as purely mechanical as the rest of their actions, and are simply accompanied by the state of consciousness called volition, the inquiry, so far as they are concerned, becomes superfluous. Their volitions do not enter into the chain of causation of their actions at all.

The hypothesis that brutes are conscious automata is perfectly consistent with any view [242] that may be held respecting the often discussed and curious question whether they have souls or not; and, if they have souls, whether those souls are immortal or not. It is obviously harmonious with the most literal adherence to the text of Scripture concerning "the beast that perisheth"; but it is not inconsistent with the amiable conviction ascribed by Pope to his "untutored savage," that when he passes to the happy hunting-grounds in the sky, "his faithful dog shall bear him company." If the brutes have consciousness and no souls, then it is clear that, in them, consciousness is a direct function of material changes; while, if they possess immaterial subjects of consciousness, or souls, then, as consciousness is brought into existence only as the consequence of molecular motion of the brain, it follows that it is an indirect product of material changes. The soul stands related to the body as the bell of a clock to the works, and consciousness answers to the sound which the bell gives out when it is struck.

Thus far I have strictly confined myself to the problem with which I proposed to deal at starting–the automatism of brutes. The question is, I believe, a perfectly open one, and I feel happy in running no risk of either Papal or Presbyterian condemnation for the views which I have ventured to put forward. And there are so very few interesting questions which one is, at present, allowed to [243] think out scientifically–to go as far as reason leads, and stop where evidence comes to an end–without speedily being deafened by the tattoo of "the drum ecclesiastic"–that I have luxuriated in my rare freedom, and would now willingly bring this disquisition to an end if I could hope that other people would go no farther. Unfortunately, past experience debars me from entertaining any such hope, even if

". . . . that drum's discordant sound

Parading round and round and round,"

were not, at present, as audible to me as it was to the mild poet who ventured to express his hatred of drums in general, in that well-known couplet.

It will be said, that I mean that the conclusions deduced from the study of the brutes are applicable to man, and that the logical consequences of such application are fatalism, materialism, and atheism–whereupon the drums will beat the *pas de charge.*

One does not do battle with drummers; but I venture to offer a few remarks for the calm consideration of thoughtful persons, untrammelled by foregone conclusions, unpledged to shore-up tottering dogmas, and anxious only to know the true bearings of the case.

It is quite true that, to the best of my judgment, the argumentation which applies to brutes [244] holds equally good of men; and, therefore, that all states of consciousness in us, as in them, are immediately caused by molecular changes of the brain-substance. It seems to me that in men, as in brutes, there is no proof that any state of consciousness is the cause of change in the motion of the matter of the organism. If these positions are well based, it follows that our mental conditions are simply the symbols in consciousness of the changes which takes place automatically in the organism; and that, to take an extreme illustration, the feeling we call volition is not the cause of a voluntary act, but the symbol of that state of the brain which is the immediate cause of that act. We are conscious automata, endowed with free will in the only intelligible sense of that much-abused term–inasmuch as in many respects we are able to do as we like–but none the less parts of the great series of causes and effects which, in unbroken continuity, composes that which is, and has been, and shall be–the sum of existence.

As to the logical consequences of this conviction of mine, I may be permitted to remark that logical consequences are the scarecrows of fools and the beacons of wise men. The only question which any wise man can ask himself, and which any honest man will ask himself, is whether a doctrine is true or false. Consequences will take care of themselves; at most their importance can only [245] justify us in testing with extra care the reasoning process from which they result.

So that if the view I have taken did really and logically lead to fatalism, materialism, and atheism, I should profess myself a fatalist, materialist, and atheist; and I should look upon those who, while they believed in my honesty of purpose and intellectual competency, should raise a hue and cry against me, as people who by their own admission preferred lying to truth, and whose opinions therefore were unworthy of the smallest attention.

But, as I have endeavoured to explain on other occasions, I really have no claim to rank myself among fatalistic, materialistic, or atheistic philosophers. Not among fatalists, for I take the conception of necessity to have a logical, and not a physical foundation; not among materialists, for I am utterly incapable of conceiving the existence of matter if there is no mind in which to picture that existence; not among atheists, for the problem of the ultimate cause of existence is one which seems to me to be

hopelessly out of reach of my poor powers. Of all the senseless babble I have ever had occasion to read, the demonstrations of these philosophers who undertake to tell us all about the nature of God would be the worst, if they were not surpassed by the still greater absurdities of the philosophers who try to prove that there is no God.

[246] And if this personal disclaimer should not be enough, let me further point out that a great many persons whose acuteness and learning will not be contested, and whose Christian piety, and, in some cases, strict orthodoxy, are above suspicion, have held more or less definitely the view that man is a conscious automaton.

It is held, for example, in substance, by the whole school of predestinarian theologians, typified by St. Augustine, Calvin, and Jonathan Edwards–the great work of the latter on the will showing in this, as in other cases, that the growth of physical science has introduced no new difficulties of principle into theological problems, but has merely given visible body, as it were, to those already existed.

Among philosophers, the pious Geulincx and the whole school of occasionalist Cartesians held this view; the orthodox Leibnitz invented the term "automate spirituel," and applied it to man; the fervent Christian, Hartley, was one of the chief advocates and best expositors of the doctrine; while another zealous apologist of Christianity in a sceptical age, and a contemporary of Hartley, Charles Bonnet, the Genevese naturalist, has embodied the doctrine in language of such precision and simplicity, that I will quote the little-known passage of his "Essai de Psychologie" at length:–

[247] "Another Hypothesis concerning the Mechanism of Ideas"[16]

"Philosophers accustomed to judge of things by that which they are in themselves, and not by their relation to received ideas, would not be shocked if they met with the proposition that the soul is a mere spectator of the movements of its body: that the latter performs of itself all that series of actions which constitutes life: that it moves of itself: that it is the body alone which reproduces ideas, compares and arranges them; which forms reasonings, imagines and executes plans of all kinds, etc. This hypothesis, though perhaps of an excessive boldness, nevertheless deserves some consideration.

"It is not to be denied that Supreme Power could create an automaton which should exactly imitate all the external and internal actions of man.

"I understand by external actions, all those movements which pass under our eyes: I term internal actions, all the motions which in the natural state cannot be observed because they take place in the interior of the body–such as the movements of digestion, circulation, sensation, etc. Moreover, I include in this category the movements which give rise to ideas, whatever be their nature.

"In the automaton which we are considering everything would be precisely determined. Everything would occur according to the rules of the most admirable mechanism: one state would succeed another state, one operation would lead to another operation, according to invariable laws; motion would become alternately cause and effect, effect and cause; reaction would answer to action, and reproduction to production.

"Constructed with definite relations to the activity of the beings which compose the world, the automaton would receive impressions from it, and, in faithful correspondence thereto, it would execute a corresponding series of motions.

"Indifferent towards any determination, it would yield [248] equally to all, if the first impressions did not, so to speak, wind up the machine and decide its operations and its course.

"The series of movements which this automaton could execute would distinguish it from all others formed on the same model, but which, not having been placed in similar circumstances, would not have experienced the same impressions, or would not have experienced them in the same order.

"The senses of the automaton, set in motion by the objects presented to it, would communicate their motion to the brain, the chief motor apparatus of the machine. This would put in action the muscles of the hands and feet, in virtue of their secret connection with the senses. These muscles, alternately contracted and dilated, would approximate or remove the automaton from the objects, in the relation which they would bear to the conservation or the destruction of the machine.

"The motions of perception and sensation which the objects would have impressed on the brain, would be preserved in it by the energy of its mechanism. They would become more vivid according to the actual condition of the automaton, considered in itself and relatively to the objects.

"Words being only the motions impressed on the organ of hearing and that of voice, the diversity of these movements, their combination, the order in which they would succeed one another, would represent judgments, reasoning, and all the operations of the mind.

"A close correspondence between the organs of the senses, either by the opening into one another of their nervous ramifications, or by interposed springs (*ressorts*), would establish such a connection in their working, that, on the occasion of the movements impressed on one of these organs, other movements would be excited, or would become more vivid in some of the other senses.

"Give the automaton a soul which contemplates its movements, which believes itself to be the author of them, which has different volitions on the occasion of the different movements, and you will on this hypothesis construct a man.

"But would this man be free? Can the feeling of our liberty this feeling which is so clear and so distinct and so vivid as to [249] persuade us that we are the authors of our actions, be conciliated with this hypothesis? If it removes the difficulty which attends the conception of the action of the soul on the body, on the other hand it leaves untouched that which meets us in endeavouring to conceive the action of the body on the soul."

But if Leibnitz, Jonathan Edwards, and Hartley–men who rank among the giants of the world of thought–could see no antagonism between the doctrine under discussion and Christian orthodoxy, is it not just possible that smaller folk may be wrong in making such a coil about "logical consequences"? And, seeing how large a share of this clamour is raised by the clergy of one denomination or another, may I say, in conclusion, that it really would be well if ecclesiastical persons would reflect that

ordination, whatever deep-seated graces it may confer, has never been observed to be followed by any visible increase in the learning or the logic of its subject. Making a man a Bishop, or entrusting him with the office of ministering to even the largest of Presbyterian congregations, or setting him up to lecture to a Church congress, really does not in the smallest degree augment such title to respect as his opinions may intrinsically possess. And when such a man presumes on an authority which was conferred upon him for other purposes to sit in judgment upon matters his incompetence to deal with which is patent, it is permissible to ignore his sacerdotal pretensions, and to tell him, [250] as one would tell a mere common, unconsecrated, layman: that it is not necessary for any man to occupy himself with problems of this kind unless he so choose; life is filled full enough by the performance of its ordinary and obvious duties. But that, if a man elect to become a judge of these grave questions; still more, if he assume the responsibility of attaching praise or blame to his fellow-men for the conclusions at which they arrive touching them, he will commit a sin more grievous than most breaches of the Decalogue, unless he avoid a lazy reliance upon the information that is gathered by prejudice and filtered through passion, unless he go back to the prime sources of knowledge–the facts of Nature, and the thoughts of those wise men who for generations past have been her best interpreters.

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[1] I quote, here and always, Cousin's edition of the works of Descartes, as most convenient for reference. It is entitled *Œuvres complèes de Descartes, publiées, par Victor Cousin.* 1824.

[2] *Les Passions de l'Âme,* Article xxxiii.

[3] *Recherches physiologiques sur la Vie et la Mort.* Par Xav. Bichat. Art. Sixième.

[4] Locke (*Human Understanding,* Book II., chap. viii. 37) uses Descartes' illustration for the same purpose, and warns us that "most of the ideas of sensation are no more the likeness of something existing without us than the names that stand for them are the likeness of our ideas, which yet, upon hearing, they are apt to excite in us," a declaration which paved the way for Berkeley.

[5] *Passions de l'Âme,* Art. xxxvi.

[6] "Quamcumque Bruti actionem, velut automati mechanici motum artificialem, in eo consistere quod se primò sensibile aliquod spiritus animales afficiens, eosque introrsum convertens, *sensionem* excitat, à qua mox iidem spiritus, velut undulatione reflexâ denuo retrorsum commoti atque pro concinno ipsius fabricæ organorum, et partium ordine, in certos nervos musculosque determinati, respectivos *membrorum motus* perficiunt."–Willis: *De Animâ Brutorum,* p. 5, ed. 1763.

[7] See above: p. 189, *note.*

[8] *Les Passions de l'Âme,* xliii.

[9] Haller, *Primæ Lineæ,* ed. iii. *Sensus interni,* dlvii.

[10] *Réponse de M. Descartes a M. Morus.* 1649. *Œuevres,* tome x. p. 204. Mais le plus grand de tous les préjugés que nous ayons retenus de notre enfance, est celui de croire que les bêtes pensent," etc.

[11] Malebranche states the view taken by orthodox Cartesians in 1689 very forcibly: "Ainsi dans les chiens, les chats, et les autres animaux, il n'y a ny intelligence, ny âme spirituelle comme on l'entend ordinairement. Ils mangent sans plaisir; ils crient sans douleur; ils croissent sans le sçavoir; ils ne desirent rien; ils ne connoissent rien; et s'ils agissent avec adresse et d'une maniere qui marque l'intelligence, c'est que Dieu les faisant pour les conserver, il a conformé leurs corps de telle manière, qu'ils évitent organiquement, sans le sçavoir, tout ce qui peut les de truire et qu'ils semblent craindre." (*Feuillet de Conches. Méditations Métaphysiques et Correspondance de. N. Malebranche. Neuvième Méditation.* 1841.)

[12] Not to be confounded with the anterior middle and hinder parts of the hemispheres of the cerebrum.

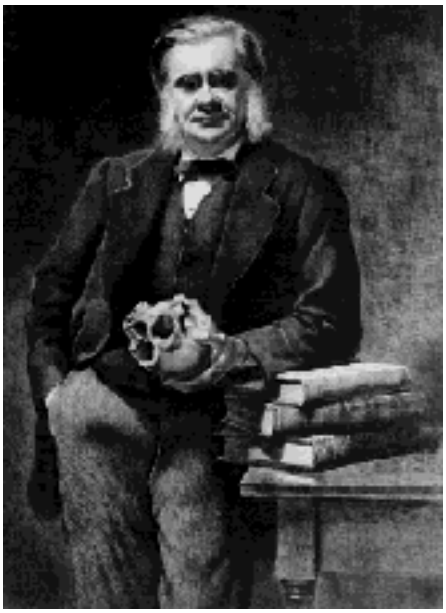
[13] See the remarkable essay of Göltz, *Beitrage zur Lehre von den Functionen der Nervencentren des Frosches,* published in 1809. I have repeated Göltz's experiments, and obtained the same results.

[14] "De l'Automatisme de la Mémoire et du Souvenir, dans le Somnambulisme pathologique." Par le Dr. E. Mesnet, Médecin de l'Hôpital Saint-Antoine. *L'Union Médicale,* Juillet 21 et 23, 1874. My attention was first called to a summary of this remarkable case, which appeared in the *Journal des Débats* for the 7th of August, 1874, by my friend General Strachey, F.R.S.

[15] Those who have had occasion to become acquainted with the phenomena of somnambulism and of mesmerism, will be struck with the close parallel which they present to the proceedings of F. in his abnormal state. But the great value of Dr. Mesnet's observations lies in the fact that the abnormal condition is traceable to a definite injury to the brain, and that the circumstances are such as to keep us clear of the cloud of voluntary and involuntary fictions in which the truth is too often smothered in such cases. In the unfortunate subjects of such abnormal conditions of the brain, the disturbance of the sensory and intellectual faculties is not unfrequently accompanied by a perturbation of the moral nature, which may manifest itself in a most astonishing love of lying for its own sake. And, in this respect, also, F.'s case is singularly instructive, for though, in his normal state, he is a perfectly honest man, in his abnormal condition he is an inveterate thief, stealing and hiding away whatever he can lay hands on, with much dexterity, and with an absurd indifference as to whether the property is his own or not. Hoffman's terrible conception of the "Doppelt-gänger" is realised by men in this state–who live two lives, in the one of which they may be guilty of the most criminal acts, while, in the other, they are eminently virtuous and respectable. Neither life knows anything of the other. Dr. Mesnet states that he has watched a man in his abnormal state elaborately prepare to hang himself, and has let him go on until asphyxia. set in, when he cut him down. But on passing into the normal state the would-be suicide was wholly ignorant of what had happened. The problem of responsibility is here as complicated as that of the prince-bishop, who swore as a prince and not as a bishop. "But, highness if the prince is damned, what will become of the bishop?" said the peasant.

[16] *Essai de Psychologie,* chap. xxvii.

THE HUXLEY FILE



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Administrative Nihilism (1871)

Collected Essays I

[251] To me, and, as I trust, to the great majority of those whom I address, the great attempt to educate the people of England which has just been set afoot, is one of the most satisfactory and hopeful events in our modern history. But it is impossible, even if it were desirable, to shut our eyes to the fact, that there is a minority, not inconsiderable in numbers, nor deficient in supporters of weight and authority, in whose judgment all this legislation is a step in the wrong direction, false in principle, and consequently sure to produce evil in practice.

The arguments employed by these objectors are of two kinds. The first is what I will venture to term the caste argument; for, if logically carried out, it would end in the separation of the people of this country into castes, as permanent and as [252] sharply defined, if not as numerous, as those of India. It is maintained that the whole fabric of society will be destroyed if the poor, as well as the rich, are educated; that anything like sound and good education will only make them discontented with their station and raise hopes which, in the great majority of cases, will be bitterly disappointed. It is said: There must be hewers of wood and drawers of water, scavengers and coal-heavers, day labourers and domestic servants, or the work of society will come to a standstill. But, if you educate and refine everybody, nobody will be content to assume these functions, and all the world will want to be gentlemen and ladies.

One hears this argument most frequently from the representatives of the well-to-do middle class; and, coming from them, it strikes me as peculiarly inconsistent, as the one thing they admire, strive after, and advise their own children to do, is to get on in the world, and, if possible, rise out of the class in which they were born into that above them. Society needs grocers and merchants as much as it needs coal-heavers; but if a merchant accumulates wealth and works his way to a baronetcy, or if the son of a greengrocer becomes a lord chancellor, or an archbishop, or, as a successful soldier, wins a peerage, all the world admires them; and looks with pride upon the social system which renders such achievements possible. [253] Nobody suggests that there is anything wrong: their being discontented with their station; or that, in their cases society suffers by men of ability reaching the positions for which Nature has fitted them.

But there are better replies than those of the *tu quoque* sort to the caste argument. In the first place, it is not true that education, as such, unfits men for rough and laborious, or even disgusting, occupations. The life of a sailor is rougher and harder than that of nine landsmen out of ten, and yet, as every ship's captain knows, no sailor was ever the worse for possessing a trained intelligence. The life of a medical practitioner, especially in the country, is harder and more laborious than that of most artisans, and he is constantly obliged to do things, which, in point of pleasantness, cannot be ranked above scavengering–yet he always ought to be, and he frequently is, a highly educated man. In the second place, though it may be granted that the words of the catechism, which require a man to do his duty in

the station to which it has pleased God to call him, give an admirable definition of our obligation to ourselves and to society; yet the question remains, how is any given person to find out what is the particular station to which it has pleased God to call him? A new-born infant does not come into the world labelled scavenger, shopkeeper, bishop or duke. One mass of red pulp is just like another to all [254] outward appearance. And it is only by finding out what his faculties are good for, and seeking, not for the sake of gratifying a paltry vanity, but as the highest duty to himself and to his fellow-men, to put himself into the position in which they can attain their full development, that the man discovers his true station. That which is to be lamented, I fancy, is not that society should do its utmost to help capacity to ascend from the lower strata to the higher, but that it has no machinery by which to facilitate the descent of incapacity from the higher strata to the lower. In that noble romance, the "Republic" (which is now, thanks to the Master of Balliol, as intelligible to us all as if it had been written in our mother tongue), Plato makes Socrates say that he should like to inculcate upon the citizens of his ideal state just one "royal lie."

"'Citizens,' we shall say to them in our tale–'You are brothers, yet God has framed you differently. Some of you have the power of command, and these He has composed of gold, wherefore also they have the greatest honour; others of silver, to be auxiliaries; others again, who are to be husbandmen and craftsmen, He has made of brass and iron; and the species will generally be preserved in the children. But as you are of the same original family, a golden parent will sometimes have a silver son, or a silver parent a golden son. And God proclaims to the rulers, as a first principle, that before all they should watch over their offspring, and see what elements mingle with their nature; for if the son of a golden or silver parent has an admixture of brass and iron, then nature orders a transposition of ranks, and the eye of the ruler must not be pitiful towards his child because he has to descend in the scale and become a [255] husbandman or artisan; just as there may be others sprung from the artisan class, who are raised to honour, and become guardians and auxiliaries. For an oracle says that when a man of brass and iron guards the State, it will then be destroyed.'"[1]

Time, whose tooth gnaws away everything else, is powerless against truth; and the lapse of more than two thousand years has not weakened the force of these wise words. Nor is it necessary that, as Plato suggests, society should provide functionaries expressly charged with the performance of the difficult duty of picking out the men of brass from those of silver and gold. Educate, and the latter will certainly rise to the top; remove all those artificial props by which the brass and iron folk are kept at the top, and, by a law as sure as that of gravitation, they will gradually sink to the bottom. We have all known noble lords who would have been coachmen, or gamekeepers, or billiard-markers, if they had not been kept afloat by our social corks; we have all known men among the lowest ranks, of whom every one has said, "What might not that man have become, if he had only had a little education?"

And who that attends, even in the most superficial way, to the conditions upon which the stability of modern society–and especially of a society like ours, in which recent legislation has placed sovereign authority in the hands of the [256] masses, whenever they are united enough to wield their power–can doubt that every man of high natural ability, who is both ignorant and miserable, is as great a danger to society as a rocket without a stick is to the people who fire it? Misery is a match that never goes out; genius, as an explosive power, beats gunpowder hollow; and if knowledge, which should give that power guidance, is wanting, the chances are not small that the rocket will simply run a-muck among

friends and foes. What gives force to the socialistic movement which is now stirring European society to its depths, but a determination on the part of the naturally able men among the proletariat, to put an end, somehow or other, to the misery and degradation in which a large proportion of their fellows are steeped? The question, whether the means by which they purpose to achieve this end are adequate or not, is at this moment the most important of all political questions–and it is beside my present purpose to discuss it. All I desire to point out is, that if the chance of the controversy being decided calmly and rationally, and not by passion and force, looks miserably small to an impartial bystander, the reason is that not one in ten thousand of those who constitute the ultimate court of appeal, by which questions of the utmost difficulty, as well as of the most momentous gravity, will have to be decided, is prepared by education to comprehend the real [257] nature of the suit brought before their tribunal.

Finally, as to the ladies and gentlemen question, all I can say is, would that every woman-child born into this world were trained to be a lady, and every man-child a gentleman! But then I do not use those much-abused words by way of distinguishing people who wear fine clothes, and live in fine houses, and talk aristocratic slang, from those who go about in fustian, and live in back slums, and talk gutter slang. Some inborn plebeian blindness, in fact, prevents me from understanding what advantage the former have over the latter. I have never even been able to understand why pigeon-shooting at Hurlingham should be refined and polite, while a rat-killing match in Whitechapel is low; or why "What a lark" should be coarse, when one hears "How awfully jolly" drop from the most refined lips twenty times in an evening.

Thoughtfulness for others, generosity, modesty, and self-respect, are the qualities which make a real gentleman, or lady, as distinguished from the veneered article which commonly goes by that name. I by no means wish to express any sentimental preference for Lazarus against Dives, but, on the face of the matter, one does not see why the practice of these virtues should be more difficult in one state of life than another; and any one who has had a wide experience among all [258] sorts and conditions of men, will, I think, agree with me that they are as common in the lower ranks of life as in the higher.

Leaving the caste argument aside then, as inconsistent with the practice of those who employ it, as devoid of any justification in theory, and as utterly mischievous if its logical consequences were carried out, let us turn to the other class of objectors. To these opponents, the Education Act is only one of a number of pieces of legislation to which they object on principle; and they include under like condemnation the Vaccination Act, the Contagious Diseases Act, and all other sanitary Acts; all attempts on the part of the State to prevent adulteration, or to regulate injurious trades; all legislative interference with anything that bears directly or indirectly on commerce, such as shipping, harbours, railways, roads, cab-fares, and the carriage of letters; and all attempts to promote the spread of knowledge by the establishment of teaching bodies, examining bodies, libraries, or museums, or by the sending out of scientific expeditions; all endeavours to advance art by the establishment of schools of design, or picture galleries; or by spending money upon an architectural public building when a brick box would answer the purpose. According to their views, not a shilling of public money must be bestowed upon a public park or pleasure ground; not sixpence upon the relief of starvation, [259] or the cure of disease. Those who hold these views support them by two lines of argument. They enforce them deductively by arguing from an assumed axiom, that the State has no right to do anything but protect its

subjects from aggression. The State is simply a policeman, and its duty is neither more nor less than to prevent robbery and murder and enforce contracts. It is not to promote good, nor even to do anything to prevent evil, except by the enforcement of penalties upon those who have been guilty of obvious and tangible assault upon purses or persons. And, according to this view, the proper form of government is neither a monarchy, an aristocracy, nor a democracy, but an *astynomocracy,* or police government. On the other hand, these views are supported *a posteriori,* by an induction from observation, which professes to show that whatever is done by a Government beyond these negative limits, is not only sure to be done badly, but to be done much worse than private enterprise would have done the same thing.

I am by no means clear as to the truth of the latter proposition. It is generally supported by statements which prove clearly enough that the State does a great many things very badly. But this is really beside the question. The State lives in a glass house; we see what it tries to do, and all its failures, partial or total, are made the most of. But private enterprise is sheltered under [260] good opaque bricks and mortar. The public rarely knows what it tries to do, and only hears of failures when they are gross and patent to all the world. Who is to say how private enterprise would come out if it tried its hand at State work? Those who have had most experience of joint-stock companies and their management, will probably be least inclined to believe in the innate superiority of private enterprise over State management. If continental bureaucracy and centralisation be fraught with multitudinous evils, surely English beadleocracy and parochial obstruction are not altogether lovely. If it be said that, as a matter of political experience, it is found to be for the best interests, including the healthy and free development, of a people, that the State should restrict itself to what is absolutely necessary, and should leave to the voluntary efforts of individuals as much as voluntary effort can be got to do, nothing can be more just. But, on the other hand, it seems to me that nothing can be less justifiable than the dogmatic assertion that State interference, beyond the limits of home and foreign police, must, under all circumstances, do harm.

Suppose, however, for the sake of argument, that we accept the proposition that the functions of the State may be properly summed up in the one great negative commandment,–"Thou shalt not allow any man to interfere with the liberty of [261] any other man,"–I am unable to see that the logical consequence is any such restriction of the power of Government, as its supporters imply. If my next-door neighbour chooses to have his drains in such a state as to create a poisonous atmosphere, which I breathe at the risk of typhoid and diphtheria, he restricts my just freedom to live just as much as if he went about with a pistol, threatening my life; if be is to be allowed to let his children go unvaccinated, he might as well be allowed to leave strychnine lozenges about in the way of mine; and if he brings them up untaught and untrained to earn their living, he is doing his best to restrict my freedom, by increasing the burden of taxation for the support of gaols and workhouses, which I have to pay.

The higher the state of civilisation, the more completely do the actions of one member of the social body influence all the rest, and the less possible is it for any one man to do a wrong thing without interfering, more or less, with the freedom of all his fellow-citizens. So that, even upon the narrowest view of the functions of the State, it must be admitted to have wider powers than the advocates of the police theory are disposed to admit.

It is urged, I am aware, that if the right of the State to step beyond the assigned limits is admitted at all,

there is no stopping; and that the principle which justifies the State in enforcing [262] vaccination or education, will also justify it in prescribing my religious belief, or my mode of carrying on my trade or profession; in determining the number of courses I have for dinner. or the pattern of my waistcoat.

But surely the answer is obvious that, on similar grounds, the right of a man to eat when he is hungry might be disputed, because if you once allow that he may eat at all, there is no stopping him until he gorges himself, and suffers all the ills of a surfeit. In practice, the man leaves off when reason tells him he has had enough; and, in a properly organised State, the Government, being nothing but the corporate reason of the community, will soon find out when State interference has been carried far enough. And, so far as my acquaintance with those who carry on the business of Government goes, I must say that I find them far less eager to interfere with the people, than the people are to be interfered with. And the reason is obvious. The people are keenly sensible of particular evils, and, like a man suffering from pain, desire an immediate remedy. The statesman, on the other hand, is like the physician, who knows that he can stop the pain at once by an opiate; but who also knows that the opiate may do more harm than good in the long run. In three cases out of four the wisest thing he can do is to wait, and leave the case to nature. But in the fourth case, in which the symptoms are [263] unmistakable, and the cause of the disease distinctly known, prompt remedy saves a life. Is the fact that a wise physician will give as little medicine as possible any argument for his abstaining from giving any at all?

But the argument may be met directly. It may be granted that the State, or corporate authority of the people, might with perfect propriety order my religion, or my waistcoat, if as good grounds could be assigned for such an order as for the command to educate my children. And this leads us to the question which lies at the root of the whole discussion–the question, namely, upon what foundation does the authority of the State rest, and how are the limits of that authority to be determined?

One of the oldest and profoundest of English philosophers, Hobbes of Malmesbury writes thus:–

"The office of the sovereign, be it monarch or an assembly, consisteth in the end for which he was entrusted with the sovereign power, namely, the procuration of the *safety* of the people: to which he is obliged by the law of nature, and to render an account thereof to God, the author of that law, and to none but Him. But by safety, here, is not meant a bare preservation, but also all other contentments of life, which every man by lawful industry, without danger or hurt to the commonwealth, shall acquire to himself."

At first sight this may appear to be a statement of the police-theory of government, pure and simple; but it is not so. For Hobbes goes on to say:

[264] "And this is intended should be done, not by care applied to individuals, further than their protection from injuries, when they shall complain; but by a general providence contained in public instruction both of doctrine and example; and in the making and executing of good laws to which individual persons may apply their own cases."[2]

To a witness of the civil war between Charles I. and the Parliament, it is not wonderful that the dissolution of the bonds of society which is involved in such strife should appear to be "the greatest evil

that can happen in this life;" and all who have read the "Leviathan" know to what length Hobbes's anxiety for the preservation of the authority of the representative of the sovereign power, whatever its shape, leads him. But the justice of his conception of the duties of the sovereign power does not seem to me to be invalidated by his monstrous doctrines respecting the sacredness of that power.

To Hobbes, who lived during the break-up of the sovereign power by popular force, society appeared to be threatened by everything which weakened that power; but, to John Locke, who witnessed the evils which flow from the attempt of the sovereign power to destroy the rights of the people by fraud and violence, the danger lay in the other direction.

The safety of the representative of the sovereign power itself is to Locke a matter of very small [265] moment, and he contemplates its abolition when it ceases to do its duty, and its replacement by another, as a matter of course. The great champion of the revolution of 1688 could do no less. Nor is it otherwise than natural that he should seek to limit, rather than to enlarge, the powers of the State, though in substance he entirely agrees with Hobbes's view of its duties:–

"But though men," says he, "when they enter into society, give up the equality, liberty, and executive power they had in the state of nature, into the hands of the society, to be so far disposed of by the Legislature as the good of society shall require; yet it being only with an intention in every one the better to preserve himself, his liberty and property (for no rational creature can be supposed to change his condition with an intention to be worse), the power of the society, or legislation, constituted by them can never be supposed to extend further than the common good, but is obliged to secure every one's property by providing against those three defects above mentioned, that made the state of nature so unsafe and uneasy. And so, whoever has the legislative or supreme power of any commonwealth, is bound to govern by established standing laws, promulgated and known to the people, and not by extemporary decrees; by indifferent and upright judges, who are to decide controversies by those laws; and to employ the force of the community at home only in the execution of such laws; or abroad, to prevent or redress foreign injuries, and secure the community from inroads and invasion. And all this is to be directed to no other end than the peace, safety, and public good of the people."[3]

Just as in the Case of Hobbes, so in that of Locke, it may at first sight appear from this passage that the latter philosopher's views of the [266] functions of government incline to the negative, rather than the positive, side. But a further study of Locke's writings will at once remove this misconception. In the famous "Letter concerning Toleration," Locke says:–

"The commonwealth seems to me to be a society of men constituted only for the procuring, preserving, and advancing their own civil interests.

"Civil interests I call life, liberty, health, and indolency of body; and the possession of outward things, such as money, lands, houses, furniture, and the like.

"It is the duty of the civil magistrate, by the impartial execution of equal laws, to secure unto all the people in general, and to every one of his subjects in particular, the just possession of those things belonging to this life.

"......The whole jurisdiction of the magistrate reaches only to these civil concernments.... All civil power, right, and dominion, is bounded and confined to the only care of promoting these things."

Elsewhere in the same "Letter," Locke lays down the proposition that if the magistrate understand washing a child "to be profitable to the curing or preventing any disease that children are subject unto, and esteem the matter weighty enough to be taken care of by a law, in that case he may order it to be done."

Locke seems to differ most widely from Hobbes by his strong advocacy of a certain measure of toleration in religious matters. But the reason why the civil magistrate ought to leave religion alone is, according to Locke, simply this, that "true and saving religion consists in the inward [267] persuasion of the mind." And since "such is the nature of the understanding that it cannot be compelled to the belief of anything by outward force," it is absurd to attempt to make men religious by compulsion. I cannot discover that Locke fathers the pet doctrine of modern Liberalism, that the toleration of error is a good thing in itself, and to be reckoned among the cardinal virtues; on the contrary, in this very "Letter on Toleration" he states in the clearest language that "No opinion contrary to human society, or to those moral rules which are necessary to the preservation of civil society, are to be tolerated by the magistrate." And the practical corollary which he draws from this proposition is that there ought to be no toleration for either Papists or Atheists.

After Locke's time the negative view of the functions of Government gradually grew in strength, until it obtained systematic and able expression in Wilhelm von Humboldt's "Ideen,"[4] the essence of which is the denial that the State has a right to be anything more than chief policeman. And, of late years, the belief in the efficacy of doing nothing, thus formulated, has acquired considerable popularity for several reasons. In the first place, men's speculative convictions have become less and less real; their tolerance is large [268] because their belief is small; they know that the State had better leave things alone unless it has a clear knowledge about them; and, with reason, they suspect that the knowledge of the governing power may stand no higher than the very low watermark of their own.

In the second place, men have become largely absorbed in the mere accumulation of wealth; and as this is a matter in which the plainest and strongest form of self-interest is intensely concerned, science (in the shape of Political Economy) has readily demonstrated that self-interest may be safely left to find the best way of attaining its ends. Rapidity and certainty of intercourse between different countries, the enormous development of the powers of machinery, and general peace (however interrupted by brief periods of warfare), have changed the face of commerce as completely as modern artillery has changed that of war. The merchant found himself as much burdened by ancient protective measures as the soldier by his armour–and negative legislation has been of as much use to the one as the stripping off of breast-plates, greaves, and buff-coat to the other. But because the soldier is better without his armour it does not exactly follow that it is desirable that our defenders should strip themselves stark naked; and it is not more apparent why *laissez-faire*–great and beneficial as it may be in all that relates to the accumulation of wealth–should be the one great commandment which the State is to obey in all other matters; and especially in those in which the justification of *laissez-faire*, namely, the keen insight given by the

strong stimulus of direct personal interest, in matters clearly understood, is entirely absent.

Thirdly, to the indifference generated by the absence of fixed beliefs, and to the confidence in the efficacy of *laissez-faire*, apparently justified by experience of the value of that principle when applied to the pursuit of wealth, there must be added that nobler and better reason for a profound distrust of legislative interference, which animates Von Humboldt and shines forth in the pages of Mr. Mill's famous Essay on Liberty–I mean the just fear lest the end should be sacrificed to the means; lest freedom and variety should be drilled and disciplined out of human life in order that the great mill of the State should grind smoothly.

One of the profoundest of living English philosophers, who is at the same time the most thoroughgoing and consistent of the champions of astynomocracy, has devoted a very able and ingenious essay[5] to the drawing out of a comparison between the process by which men have advanced from the savage state to the highest civilisation, and that by which an animal passes from the condition of an almost shapeless and [270] structureless germ, to that in which it exhibits a highly complicated structure and a corresponding diversity of powers. Mr. Spencer says with great justice–

"That they gradually increase in mass; that they become, little by little, more complex; that, at the same time, their parts grow more mutually dependent; and that they continue to live and grow as wholes, while successive generations of their units appear and disappear,–are broad peculiarities which bodies politic display, in common with all living bodies, and in which they and living bodies differ from everything else."

In a very striking passage of this essay Mr. Spencer shows with what singular closeness a parallel between the development of a nervous system, which is the governing power of the body in the series of animal organisms, and that of government, in the series of social organisms, can be drawn:–

"Strange as the assertion will be thought," says Mr. Spencer "our Houses of Parliament discharge in the social economy functions that are, in sundry respects, comparable to those discharged by the cerebral masses in a vertebrate animal..... The cerebrum co-ordinates the countless heterogeneous considerations which affect the present and future welfare of the individual as a whole; and the Legislature co-ordinates the countless heterogeneous considerations which affect the immediate and remote welfare of the whole community. We may describe the office of the brain as that of *averaging* the interests of life, physical, intellectual, moral, social; and a good brain is one in which the desires answering to their respective interests are so balanced, that the conduct they jointly dictate sacrifices none of them. Similarly we may describe the office of Parliament as that of *averaging* the interests of the various classes in a com[271]munity; and a good Parliament is one in which the parties answering to these respective interests are so balanced, that their united legislation concedes to each class as much as consists with the claims of the rest."

All this appears to be very just. But if the resemblances between the body physiological and the body politic are any indication, not only of what the latter is, and how it has become what it is, but of what it ought to be, and what it is tending to become, I cannot but think that the real force of the analogy is totally opposed to the negative view of State function.

Suppose that, in accordance with this view, each muscle were to maintain that the nervous system had no right to interfere with its contraction, except to prevent it from hindering the contraction of another muscle; or each gland, that it had a right to secrete, so long as its secretion interfered with no other; suppose every separate cell left free to follow its own "interest," and *laissez-faire* lord of all, what would become of the body physiological?

The fact is that the sovereign power of the body thinks for the physiological organism, acts for it, and rules the individual components with a rod of iron. Even the blood-corpuscles can't hold a public meeting without being accused of "congestion"–and the brain, like other despots whom we have known, calls out at once for the use of sharp steel against them. As in Hobbes's [272] "Leviathan," the representative of the sovereign authority in the living organism, though he derives all his powers from the mass which he rules, is above the law. The questioning of his authority involves death, or that partial death which we call paralysis. Hence, if the analogy of the body politic with the body physiological counts for anything, it seems to me to be in favour of a much larger amount of governmental interference than exists at present, or than I, for one, at all desire to see. But, tempting as the opportunity is, I am not disposed to build up any argument in favour of my own case upon this analogy, curious, interesting, and in many respects close, as it is, for it takes no cognisance of certain profound and essential differences between the physiological and the political bodies.

Much as the notion of a "social contract" has been ridiculed, it nevertheless seems to be clear enough, that all social organisation whatever depends upon what is substantially a contract, whether expressed or implied, between the members of the society. No society ever was, or ever can be, really held together by force. It may seem a paradox to say that a slaveholder does not make his slaves work by force, but by agreement. And yet it is true. There is a contract between the two which, if it were written out, would run in these terms:–"I undertake to feed, clothe, house, [273] and not to kill, flog, or otherwise maltreat you, Quashie, if you perform a certain amount of work." Quashie, seeing no better terms to be had, accepts the bargain, and goes to work accordingly. A highwayman who garrotes me, and then clears out my pockets, robs me by force in the strict sense of the words; but if he puts a pistol to my head and demands my money or my life, and I, preferring the latter, hand over my purse, we have virtually made a contract, and I perform one of the terms of that contract. If, nevertheless, the highwayman subsequently shoots me, everybody will see that, in addition to the crimes of murder and theft, he has been guilty of a breach of contract.

A despotic Government, therefore, though often a mere combination of slaveholding and highway robbery, nevertheless implies a contract between governor and governed, with voluntary submission on the part of the latter; and *a fortiori*, all other forms of government are in like case.

Now a contract between any two men implies a restriction of the freedom of each in certain particulars. The highwayman gives up his freedom to shoot me, on condition of my giving up my freedom to do as I like with my money: I give up my freedom to kill Quashie, on condition of Quashie's giving up his freedom to be idle. And the essence and foundation of every social organisation, whether simple or complex, is the [274] fact that each member of the society voluntarily renounces his freedom in certain directions, in return for the advantages which he expects from association with the other members of that

society. Nor are constitutions, laws, or manners, in ultimate analysis, anything but so many expressed or implied contracts between the members of a society to do this, or abstain from that.

It appears to me that this feature constitutes the difference between the social and the physiological organism. Among the higher physiological organisms, there is none which is developed by the conjunction of a number of primitively independent existences into a complex whole. The process of social organisation appears to be comparable, not so much to the process of organic development, as to the synthesis of the chemist, by which independent elements are gradually built up into complex aggregations–in which each element retains an independent individuality, though held in subordination to the whole. The atoms of carbon and hydrogen, oxygen, nitrogen, which enter into a complex molecule, do not lose the powers originally inherent in them, when they unite to form that molecule, the properties of which express those forces of the whole aggregation which are not neutralised and balanced by one another. Each atom has given up something, in order that the atomic society, or molecule, may subsist. And as soon as any one or more of the [275] atoms thus associated resumes the freedom which it has renounced, and follows some external attraction, the molecule is broken up, and all the peculiar properties which depended upon its constitution vanish.

Every society, great or small, resembles such a complex molecule, in which the atoms are represented by men, possessed of all those multifarious attractions and repulsions which are manifested in their desires and volitions, the unlimited power of satisfying which, we call freedom. The social molecule exists in virtue of the renunciation of more or less of this freedom by every individual. It is decomposed, when the attraction of desire leads to the resumption of that freedom, the suppression of which is essential to the existence of the social molecule. And the great problem of that social chemistry we call politics, is to discover what desires of mankind may be gratified, and what must be suppressed, if the highly complex compound, society, is to avoid decomposition. That the gratification of some of men's desires shall be renounced is essential to order; that the satisfaction of others shall be permitted is no less essential to progress; and the business of the sovereign authority–which is, or ought to be, simply a delegation of the people appointed to act for its good–appears to me to be, not only to enforce the renunciation of the anti-social desires, but, wherever it may be [276] necessary, to promote the satisfaction of those which are conducive to progress.

The great metaphysician, Immanuel Kant, who is at his greatest when he discusses questions which are not metaphysical, wrote, nearly a century ago, a wonderfully instructive essay entitled "A Conception of Universal History in relation to Universal Citizenship,"[6] from which I will borrow a few pregnant sentences:–

"The means of which Nature has availed herself, in order to bring about the development of all the capacities of man, is the antagonism of those capacities to social organisation, so far as the latter does in the long run necessitate their definite correlation. By antagonism, I here mean the unsocial sociability of mankind–that is, the combination in them of an impulse to enter into society, with a thorough spirit of opposition which constantly threatens to break up this society. The ground of this lies in human nature. Man has an inclination to enter into society, because in that state he feels that he becomes more a man, or, in other words, that his natural faculties develop. But he has also a great tendency to isolate himself, because he is, at the same time, aware of the unsocial

peculiarity of desiring to have everything his own way; and thus, being conscious of an inclination to oppose others, he is naturally led to expect opposition from them.

"Now it is this opposition which awakens all the dormant powers of men, stimulates them to overcome their inclination to be idle, and, spurred by the love of honour, or power, or wealth, to make themselves a place among their fellows, whom they can neither do with, nor do without.

[277] "Thus they make the first steps from brutishness towards culture, of which the social value of man is the measure. Thus all talents become gradually developed, taste is formed, and by continual enlightenment the foundations of a way of thinking are laid, which gradually changes the mere rude capacity of moral perception into determinate practical principles; and thus society, which is originated by a sort of pathological compulsion, becomes metamorphosed into a moral unity." (*Loc. cit.* p. 147)

"All the culture and art which adorn humanity, the most refined social order, are produced by that unsociability which is compelled by its own existence to discipline itself, and so by enforced art to bring the seeds implanted by Nature into full flower." (*Loc. cit.* p. 148.)

In these passages, as in others of this remarkable tract, Kant anticipates the application of the "struggle for existence" to politics, and indicates the manner in which the evolution of society has resulted from the constant attempt of individuals to strain its bonds. If individuality has no play, society does not advance; if individuality breaks out of all bounds, society perishes.

But when men living in society once become aware that their welfare depends upon two opposing tendencies of equal importance–the one restraining, the other encouraging, individual freedom–the question "What are the functions of Government?" is translated into another–namely, "What ought we men, in our corporate capacity, to do, not only in the way of restraining that free individuality which is inconsistent with the existence of society, but in encouraging that [278] free individuality which is essential to the evolution of the social organisation? The formula which truly defines the function of Government must contain the solution of both the problems involved, and not merely of one of them.

Locke has furnished us with such a formula, in the noblest, and at the same time briefest, statement of the purpose of government known to me:–

The End of Government Is the Good of Mankind[7]

But the good of mankind is not a something which is absolute and fixed for all men, whatever their capacities or state of civilisation. Doubtless it is possible to imagine a true "Civitas Dei," in which every man's moral faculty shall be such as leads him to control all those desires which run counter to the good of mankind, and to cherish only those which conduce to the welfare of society; and in which every man's native intellect shall be sufficiently strong, and his culture sufficiently extensive, to enable him to know what he ought to do and to seek after. And, in that blessed State, police will be as much a superfluity as every other kind of government.

But the eye of man has not beheld that State, and is not likely to behold it for some time to [279] come.

What we do see, in fact, is that States are made up of a considerable number of the ignorant and foolish, a small proportion of genuine knaves, and a sprinkling of capable and honest men, by whose efforts the former are kept in a reasonable state of guidance, and the latter of repression. And, such being the case, I do not see how any limit whatever can be laid down as to the extent to which, under some circumstances, the action of Government may be rightfully carried.

Was our own Government wrong in suppressing Thuggee in India? If not, would it be wrong in putting down any enthusiast who attempted to set up the worship of Astarte in the Haymarket? Has the State no right to put a stop to gross and open violations of common decency? And if the State has, as I believe it has, a perfect right to do all these things, are we not bound to admit, with Locke, that it may have a right to interfere with "Popery" and "Atheism," if it be really true that the practical consequences of such beliefs can be proved to be injurious to civil society? The question where to draw the line between those things with which the State ought, and those with which it ought not, to interfere, then, is one which must be left to be decided separately for each individual case. The difficulty which meets the statesman is the same as that which meets us all in individual life, in which our abstract [280] rights are generally clear enough, though it is frequently extremely hard to say at what point it is wise to cease our attempts to enforce them.

The notion that the social body should be organised in such a manner as to advance the welfare of its members, is as old as political thought; and the schemes of Plato, More, Robert Owen, St. Simon, Comte, and the modern socialists, bear witness that, in every age, men whose capacity is of no mean order, and whose desire to benefit their fellows has rarely been excelled, have been strongly, nay, enthusiastically, convinced that Government may attain its end–the good of the people–by some more effectual process than the very simple and easy one of putting its hands in its pockets, and letting them alone.

It may be, that all the schemes of social organisation which have hitherto been propounded are impracticable follies. But if this be so the fact proves, not that the idea which underlies them is worthless, but only that the science of politics is in a very rudimentary and imperfect state. Politics, as a science, is not older than astronomy; but though the subject-matter of the latter is vastly less complex than that of the former, the theory of the moon's motions is not quite settled yet.

Perhaps it may help us a little way towards getting clearer notions of what the State may and [281] what it may not do, if, assuming the truth of Locke's maxim that 'The end of Government is the good of mankind," we consider a little what the good of mankind is.

I take it that the good of mankind means the attainment, by every man, of all the happiness which he can enjoy without diminishing the happiness of his fellow men.[8]

If we inquire what kinds of happiness come under this definition, we find those derived from the sense of security or peace; from wealth, or commodity, obtained by commerce; from Art–whether it be architecture, sculpture, painting, music, or literature; from knowledge, or science; and, finally, from

sympathy, or friendship. No man is injured, but the contrary, by peace. No man is any the worse off because another acquires wealth by trade, or by the exercise of a profession; on the contrary, he cannot have acquired his wealth, except by benefiting others to the full extent of what they considered to be its value; and his wealth is no more than fairy gold if he does not go on benefiting others in [282] the same way. A thousand men may enjoy the pleasure derived from a picture, a symphony, or a poem, without lessening the happiness of the most devoted connoisseur. The investigation of Nature is an infinite pasture-ground, where all may graze, and where the more bite, the longer the grass grows, the sweeter is its flavour, and the more it nourishes. If I love a friend, it is no damage to me, but rather a pleasure, if all the world also love him and think of him as highly as I do.

It appears to be universally agreed, for the reasons already mentioned, that it is unnecessary and undesirable for the State to attempt to promote the acquisition of wealth by any direct interference with commerce. But there is no such agreement as to the further question whether the State may not promote the acquisition of wealth by indirect means. For example, may the State make a road, or build a harbour, when it is quite clear that by so doing it will open up a productive district, and thereby add enormously to the total wealth of the community? And if so, may the State, acting for the general good, take charge of the means of communication between its members, or of the postal and telegraph services? I have not yet met with any valid argument against the propriety of the State doing what our Government does in this matter; except the assumption, which remains to be [283] proved, that Government will manage these things worse than private enterprise would do. Nor is there any agreement upon the still more important question whether the State ought, or ought not, to regulate the distribution of wealth. If it ought not, then all legislation which regulates inheritance–the Statute of Mortmain, and the like–is wrong in principle; and, when a rich man dies, we ought to return to the state of Nature, and have a scramble for his property. If, on the other hand, the authority of the State is legitimately employed in regulating these matters, then it is an open question, to be decided entirely by evidence as to what tends to the highest good of the people, whether we keep our present laws, or whether we modify them. At present the State protects men in the possession and enjoyment of their property, and defines what that property is. The justification for its so doing is that its action promotes the good of the people. If it can be clearly proved that the abolition of property would tend still more to promote the good of the people, the State will have the same justification for abolishing property that it now has for maintaining it.

Again, I suppose it is universally agreed that it would be useless and absurd for the State to attempt to promote friendship and sympathy between man and man directly. But I see no reason why, if it be otherwise expedient, the State [284] may not do something towards that end indirectly. For example, I can conceive the existence of an Established Church which should be a blessing to the community. A Church in which, week by week, services should be devoted, not to the iteration of abstract propositions in theology, but to the setting before men's minds of an ideal of true, just, and pure living; a place in which those who are weary of the burden of daily cares, should find a moment's rest in the contemplation of the higher life which is possible for all, though attained by so few; a place in which the man of strife and of business should have time to think how small, after all, are the rewards he covets compared with peace and charity. Depend upon it, if such a Church existed, no one would seek to disestablish it.

Whatever the State may not do, however, it is universally agreed that it may take charge of the maintenance of internal and external peace. Even the strongest advocate of administrative nihilism admits that Government may prevent aggression of one man on another. But this implies the maintenance of an army and navy, as much as of a body of police; it implies a diplomatic as well as a detective force; and it implies, further, that the State, as a corporate whole, shall have distinct and definite views as to its wants, powers, and obligations.

For independent States stand in the same [285] relation to one another as men in a state of nature, or unlimited freedom. Each endeavours to get all it can, until the inconvenience of the state of war suggests either the formation of those express contracts we call treaties, or mutual consent to those implied contracts which are expressed by international law. The moral rights of a State rest upon the same basis as those of an individual. If any number of States agree to observe a common set of international laws, they have, in fact, set up a sovereign authority or supra-national government, the end of which, like that of all governments, is the good of mankind; and the possession of as much freedom by each State, as is consistent with the attainment of that end. But there is this difference: that the government thus set up over nations is ideal, and has no concrete representative of the sovereign power; whence the only way of settling any dispute finally is to fight it out. Thus the supra-national society is continually in danger of returning to the state of nature, in which contracts are void; and the possibility of this contingency justifies a government in restricting the liberty of its subjects in many ways that would otherwise be unjustifiable.

Finally, with respect to the advancement of science and art. I have never yet had the good fortune to hear any valid reason alleged why that corporation of individuals we call the State may not do what voluntary effort fails in doing, either [286] from want of intelligence or lack of will. And here it cannot be alleged that the action of the State is always hurtful. On the contrary, in every country in Europe, universities, public libraries, picture galleries, museums, and laboratories, have been established by the State, and have done infinite service to the intellectual and moral progress and the refinement of mankind.

A few days ago I received from one of the most eminent members of the Institut of France a pamphlet entitled "Pourquoi la France n'a pas trouve d'hommes supérieurs au moment du péril." The writer, M. Pasteur, has no doubt that the cause of the astounding collapse of his countrymen is to be sought in the miserable neglect of the higher branches of culture, which has been one of the many disgraces of the Second Empiree if not of its predecessors.

"Au point où nous somnes arrivés de ce qu'on appelle la *civilisation modern,* la culture des sciences dans leur expression la plus élevée est peut-être plus necessaire encore a l'état moral d'une nation qu'à sa prospérité matérielle.

"Les grandes découvertes, les méditations de la pensée dans les arts, dans les sciences et dans les lettres, en un mot les travaux désintéressés de l'esprit dans tous les genres, les centres d'enseignement propres à les faire connaître, introduisent dans le corps social tout entier l'esprit philosophique ou scientifique, cet esprit de discernement qui soumet tout à une raison sévère, condamne l'ignorance, dissipe les préjugés et les erreurs. Ils élèvent le niveau intellectuel, le sentiment moral; par eux, l'idée divine elle-méme se répand et s'exalte.... Si, au

moment du péril suprême, la France n'a pas trouvé des hommes supérieurs pour mettre en oeuvre ses resources et [287] le courage de ses enfants, il faut l'attribuer, j'en ai la conviction, à ce que la France s'est désintéressée, depuis un demi-siécle, des grands travaux de la pensée, particulièrement dans les sciences exactes."

Individually, I have no love for academies on the continental model, and still less for the system of decorating men of distinction in science, letters, or art, with orders and titles, or enriching them with sinecures. What men of science want is only a fair day's wages for more than a fair day's work; and most of us, I suspect, would be well content if, for our days and nights of unremitting toil, we could secure the pay which a first-class Treasury clerk earns without any obviously trying strain upon his faculties. The sole order of nobility which, in my judgment, becomes a philosopher, is that rank which he holds in the estimation of his fellow-workers, who are the only competent judges in such matters. Newton and Cuvier lowered themselves when the one accepted an idle knighthood, and the other became a baron of the empire. The great men who went to their graves as Michael Faraday and George Grote seem to me to have understood the dignity of knowledge better when they declined all such meretricious trappings.

But it is one thing for the State to appeal to the vanity and ambition which are to be found in philosophical as in other breasts, and another to offer men who desire to do the hardest of work for [288] the most modest of tangible rewards, the means of making themselves useful to their age and generation. And this is just what the State does when it founds a public library or museum, or provides the means of scientific research by such grants of money as that administered by the Royal Society.

It is one thing, again, for the State to take all the higher education of the nation into its own hands; it is another to stimulate and to aid, while they are yet young and weak, local efforts to the same end. The Midland Institute, Owens College in Manchester, the newly-instituted Science College in Newcastle, are all noble products of local energy and munificence. But the good they are doing is not local–the commonwealth, to its uttermost limits, shares in the benefits they confer; and I am at a loss to understand upon what principle of equity the State, which admits the principle of payment on results, refuses to give a fair equivalent for these benefits; or on what principle of justice the State, which admits the obligation of sharing the duty of primary education with a locality, denies the existence of that obligation when the higher education is in question.

To sum up: If the positive advancement of the peace, wealth, and the intellectual and moral development of its members, are objects which the Government, as the representative of the corporate authority of society, may justly strive [289] after, in fulfilment of its end–the good of mankind; then it is clear that the Government may undertake to educate the people. For education promotes peace by teaching men the realities of life and the obligations which are involved in the very existence of Society; it promotes intellectual development, not only by training the individual intellect, but by sifting out from the masses of ordinary or inferior capacities, those who are competent to increase the general welfare by occupying higher positions; and, lastly, it promotes morality and refinement, by teaching men to discipline themselves, and by leading them to see that the highest, as it is the only permanent, content is to be attained, not by grovelling in the rank and steaming valleys of sense, but by continual striving towards those high peaks, where, resting in eternal calm, reason discerns the undefined but bright ideal of the highest Good–"a cloud by day, a pillar of fire by night."

[1] *The Dialogues of Plato.* Translated into English, with Analysis and Introduction, by B. Jowett, M. A. Vol. ii, p. 243.

[2] *Leviathan,* Molesworth's ed. p. 322.

[3] Locke's Essay, *Of Civil Government,* § 131.

[4] An English translation has been published under the title of *Essay on the Sphere and Duties of Government.*

[5] *The Social Organism:* Essays. Second Series.

[6] *Idee zu einer allgemeinen Geschichte in weltbürgerlicher Absicht,* 1784. This paper has been translated by De Quincey, and attention has been recently drawn to its "signal merits" by the Editor of the *Fortnightly Review* in his Essay on Condorcet. (*Fortnightly Review,* No. xxxviii, N.S., pp. 136, 137.)

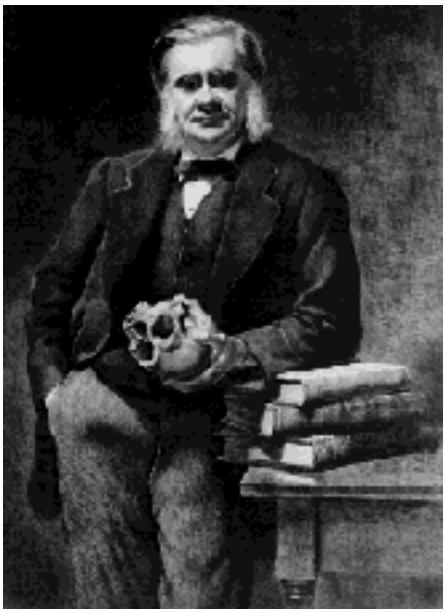
[7] *Of Civil Government,* § 229.

[8] "Hic est itaque finis ad quem tendo, talem scilicet Naturam acquirere, et ut multi mecum eam acquirant, conari hoc est de mea felicitate etiam operam dare, ut alii multi idem atque ego intelligant, ut eorum intellectus et cupiditas prorsus cum meo intellectu et cupiditate conveniant: atque hoc fiat, necesse est tantum de Natura intelligere, quantum sufficit ad talem naturam acquirendam; deinde formare talem societatem qua1is est desideranda, ut quam plurimi quam facillime et secure eo pervenlant."–B. Spinoza, *De Intellectus Emendations Tractatus.*

Dogbite

T. H. H. drawing on proof of Spencer's *Principles of Biology* 1864

THE HUXLEY FILE



Preface and Table of Contents to Volume I, *Results and Methods*, of Huxley's *Collected Essays.*

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C. Blinderman & D. Joyce
Clark University

On The Natural Inequality of Men (January 1890)

Collected Essays I

[290] The political speculations set forth in Rousseau's "Discours sur l'origine de l'inégalité parmi les hommes," and in the more noted essay, "Du Contrat Social," which were published, the former in 1754 and the latter eight years later, are, for the most part, if not wholly, founded upon conceptions with the origination of which he had nothing to do. The political, like the religious, revolutionary intellectual movement of the eighteenth century in France came from England. Hobbes, primarily, and Locke, secondarily (Rousseau was acquainted with the writings of both), supplied every notion of fundamental importance which is to be found in the works which I have mentioned. But the skill of a master of the literary art and the fervour of a prophet combined to embellish and [291] intensify the new presentation of old speculations; which had the further good fortune to address itself to a public as ripe and ready as Balak himself to accept the revelations of any seer whose prophecies were to its mind.

Missionaries, whether of philosophy or of religion, rarely make rapid way, unless their preachings fall in with the prepossessions of the multitude of shallow thinkers, or can be made to serve as a stalking-horse for the promotion of the practical aims of the still larger multitude, who do not profess to think much, but are quite certain they want a great deal. Rousseau's writings are so admirably adapted to touch both these classes that the effect they produced, especially in France, is easily intelligible. For, in the middle of the eighteenth century, French society (not perhaps so different as may be imagined from other societies before and since) presented two large groups of people who troubled themselves about politics–in any sense other than that of personal or party intrigue. There was an upper stratum of luxurious idlers, jealously excluded from political action and consequently ignorant of practical affairs, with no solid knowledge or firm principles of any sort; but, on the other hand, open-minded to every novelty which could be apprehended without too much trouble, and exquisitely appreciative of close deductive reasoning and clear exposition. Such a public [292] naturally welcomed Rousseau's brilliant developments of plausible first principles by the help of that *a priori* method which saves so much troublesome investigation.[1] It just suited the "philosophes," male and female, interchanging their airy epigrams in salons, which had about as much likeness to the Academy or to the Stoa, as the "philosophes" had to the philosophers of antiquity.

I do not forget the existence of men of the type of Montesquieu or D'Argenson in the France of the eighteenth century, when I take this as a fair representation of the enlightened public of that day. The unenlightened public, on the other hand, the people who were morally and physically debased by sheer hunger; or those, not so far dulled or infuriated by absolute want, who yet were maddened by the wrongs of every description inflicted upon them by a political system, which so far as its proper object, the welfare of the [293] people, was concerned was effete and powerless; the subjects of a government smitten with paralysis for everything but the working of iniquity and the generation of scandals; these naturally hailed with rapture the appearance of the teacher who clothed passion in the garb of philosophy; and preached the sweeping away of injustice by the perpetration of further injustice, as if it

were nothing but the conversion of sound theory into practice.

It is true that any one who has looked below the surface[2] will hardly be disposed to join in the cry which is so often raised against the "philosophes" that their "infidel and levelling" principles brought about the French Revolution. People, with political eyes in their heads, like the Marquis d'Argenson, saw that the Revolution was inevitable before Rousseau wrote a line. In truth, the Bull "Unigenitus," the interested restiveness of the Parliaments and the extravagances and profligacy of the Court had a great deal more influence in generating the catastrophe than all the "philosophes" that ever put pen to paper. But, undoubtedly, Rousseau's extremely attractive and [294] widely read writings did a great deal to a colour of rationality to those principles of '89[3] which, even after the lapse of a century, are considered by a good many people to be the Magna Charta of the human race. "Liberty, Equal and Fraternity," is still the war-cry of those, and they are many, who think, with Rousseau, that human sufferings must needs be the consequence of the artificial arrangements of society and can all be alleviated or removed by political changes.

The intellectual impulse which may thus be fairly enough connected with the name of the Genevese dreamer has by no means spent itself in the century and a half which has elapsed since it was given. On the contrary, after a period of comparative obscurity (at least outside France), Rousseauism has gradually come to the front again, and at present promises to exert once more a very grave influence on practical life. The two essays to which I have referred are, to all appearance, very little known to the present generation of those who have followed in Rousseau's track. None the less is it true that his teachings, filtered [295] through innumerable channels and passing under other names, are still regarded as the foundations of political science by the existing representatives of the classes who were so much attracted by them when they were put forth. My friend, Mr. John Morley, who probably knows more about Rousseau and his school than anybody else,[4] must have been entertained (so far as amusement is possible to the subject of the process of "heckling") when Rousseau's *plats*, the indigestibility of which he exposed so many years ago, were set before him as a wholesome British dish; the situation had a certain piquancy, which no one would appreciate more keenly.

I happened to be very much occupied upon subjects of a totally different character, and had no mind to leave them, when the narrative of this occurrence and some letters to which it gave rise, appeared in the "Times." But I have very long entertained the conviction that the revived Rousseauism of our day is working sad mischief, leading astray those who have not the time, even when they possess the ability, to go to the root of the superficially plausible doctrines which are disseminated among them. And I thought it was [296] my duty to see whether some thirty years' training in the art of making difficult questions intelligible to audiences without much learning, but with that abundance of keen practical sense which characterises English workmen of the better class, would enable me to do something towards the counteraction of the fallacious guidance which is offered to them. Perhaps I may be permitted to add that the subject was by no means new to me. Very curious cases of communal organisation and difficult questions involving the whole subject of the rights of property come before those whose duty it is to acquaint themselves with the condition of either sea or freshwater fisheries, or with the administration of Fishery Laws. For a number of years it was my fate to discharge such duties to the best of my ability;

and, in doing so, I was brought face to face with the problem of landownership and the difficulties which arise out of the conflicting claims of commoners and owners in severalty. And I had good reason to know that mistaken theories on these subjects are very liable to be translated into illegal actions. I cannot say whether the letters which I wrote in any degree attained the object (of vastly greater importance, to my mind, than any personal question) which I had in view. But I was quite aware, whatever their other results, they would probably involve me in disagreeable consequences; and, among the rest, in the necessity of proving a [297] variety of statements, which I could only adumbrate within the compass of the space that the "Times" could afford me, liberal as the editor showed himself to be in that respect. What I purpose to do in the course of the present essay is to make good these shortcomings; to show what Rousseau's doctrines were; and to inquire into their scientific value–with, I hope, that impartiality which it beseems us to exhibit in inquiries into ancient history. Having done this I propose to leave the application of the conclusions at which I arrive to the intelligence of my readers, as I shall thus escape collision with several of my respected contemporaries.[5]

I have indicated two sources from which our knowledge of Rousseau's system may be derived, and it is not worth while to go any further. But it is needful to observe that the dicta of the author of the "Contrat Social," published in 1762, are not un[298]frequently very hard–indeed I might say impossible–to reconcile with those of the author of the "Discours," which appeared eight years earlier; and that, if any one should maintain that the older essay was not meant to be taken seriously, or that it has been, in some respects, more or less set aside by the later, he might find strong grounds for his opinion. It is enough for me that the same *a priori* method and the same fallacious assumptions pervade both.

The thesis of the earlier work is that man, in the "state of nature," was a very excellent creature indeed, strong, healthy, good and contented; and that all the evils which have befallen him, such as feebleness, sickness, wickedness, and misery, result from his having forsaken the "state of nature" for the "state of civilisation." And the first step in this downward progress was the setting up of rights of several property. It might seem to a plain man that the argument here turns on a matter of fact: if it is not historically true that men were once in this "state of nature"–what becomes of it all? However, Rousseau tells us, in the preface to the "Discours," not only that the "state of nature" is something which no longer exists, but that "perhaps it never existed, and probably never will exist." Yet it is something "of which it is nevertheless necessary to have accurate notions in order to judge our present condition rightly." After making this singular statement, Rousseau goes on to observe: "Il faudrait même plus de philosophie [299] qu'on ne pense à celui qui entreprendrait de déterminer exactement les précautions à prendre pour faire sur ce sujet de solides observations." And, certainly, the amount of philosophy required to base an argument on that which does not exist, has not existed, and, perhaps, never will exist, may well seem unattainable–at any rate, at first sight. Yet, apart from analogies which might be drawn from the mathematical sciences–where, for example, a straight line is a thing which has not existed, does not exist, and probably never will exist, and yet forms a good ground for reasoning; and the value of which I need not stop to discuss–I take it that Rousseau has a very comprehensible idea at the bottom of this troublesome statement. What I conceive him to mean is that it is possible to form an ideal conception of what ought to be the condition of mankind;[6] and that, having done so, we are bound to judge the existing state of things by that ideal. That assumption puts us on the "high *a priori* road" at once.

[300] I do not suppose that any one is inclined to doubt the usefulness of a political ideal as a goal towards which social conduct should strive, whether it can ever be completely realised or not; any more than any one will doubt that it is useful to have a moral ideal towards which personal conduct should tend, even though one may never reach it. Certainly, I am the last person to question this, or to doubt that politics is as susceptible of treatment by scientific method as any other field of natural knowledge.[7] But it will be admitted that, great as are the advantages of having a political ideal, fashioned by an absolute rule of political conduct, it is perhaps better to do without one, rather than to adopt the first phantasm, bred of fallacious reasonings and born of the unscientific imagination, which presents itself. The benighted traveller, lost on a moor, who refuses to follow a man with a lantern is surely not to be commended. But suppose his hesitation arises from a well-grounded doubt as to whether the seeming luminary is anything but a will o' the wisp? And, unless I fail egregiously in attaining [301] my purpose, those who read this paper to the end will, I think, have no doubt that the political lantern of Rousseauism is a mere corpse candle and will plunge those who follow it in the deepest of anarchic bogs.

There is another point which must be carefully borne in mind in any discussion of Rousseau's doctrines; and that is the meaning which he attaches to the word "inequality." A hundred and fifty years ago, as now, political and biological philosophers found they were natural allies.[8] Rousseau is not intelligible without Buffon, with whose earlier works he was evidently acquainted, and whose influence in the following passage is obvious:–

"It is easy to see that we must seek the primary cause of the differences by which men are distinguished in these successive changes of the human constitution; since it is universally admitted that they are, naturally, as equal among themselves as were the animals of each species before various physical causes had produced, in some of them, the varieties which we observe. In fact, it is not conceivable that these first changes, by whatever means they were brought about, altered, at once and in the same way, all the individuals of a species; but some having become improved or deteriorated, and having acquired different qualities, good or bad, which were not inherent in their nature, the others remained longer in their [302] original state; and such was the first source of inequality among men, which is more easy to prove thus, in a general way, than to assign exactly to its true causes." ("Discours," Preface.)

In accordance with this conception of the origin of inequality among men, Rousseau distinguishes, at the outset of the "Discours," two kinds of inequality:–

"the one which I term *natural*, or *physical*, because it is established by Nature, and which consists in the differences of age, health, bodily strength, and intellectual or spiritual qualities; the other, which may be called *moral*, or *political*, because it depends on a sort of convention, and is established, or at least authorised, by the consent of mankind. This last inequality consists in the different privileges which some enjoy, to the prejudice of others, as being richer, more honoured, more powerful than they, or by making themselves obeyed by others."

Of course the question readily suggests itself: Before drawing this sharp line of demarcation between natural and political inequality, might it not be as well to inquire whether they are not intimately connected, in such a manner that the latter is essentially a consequence of the former? This question is

indeed put by Rousseau himself. And, as the only answer he has to give is a piece of silly and insincere rhetoric about its being a question fit only for slaves to discuss in presence of their masters, we may fairly conclude that he knew well enough he dare not grapple with it. The only safe course for him was to go by on the [303] other side and as far as the breadth of the road would permit; and, in the rest of his writings to play fast and loose with the two senses of inequality, as convenience might dictate.

With these preliminary remarks kept well in view, we may proceed to the discussion of those fundamental theses of the "Discourse" and of the "Social Contract" which Rousseau calls the "principes du droit politique." Rousseau defines his object thus:–

"Je veux chercher si dans l'ordre civil il peut y avoir quelque règle d'administration légitime et sûre, en prenant les hommes tels qu'ils sont et les lois tels qu'elles peuvent être. Je tâcherai d'allier toujours dans cette recherche ce que le droit permet avec ce que l'intérét prescrit, afin que la justice et l'utilité ne se trouvent point divisées."[9]

In other words, our philosopher propounds "sure," that is "absolute," principles which are, at once ethically and politically, sufficient rules of conduct, and that I understand to be the precise object of all who have followed in his track. It was said of the Genevese theorist, "Le [304] genre humain avait perdu ses titres; Jean Jacques les a retrouvés "; just as his intellectual progeny declare that the nation ought to "resume" the landed property of which it has, unfortunately, lost the title-deeds.

We are now in a position to consider what the chief of these principles of the gospel according to Jean-Jacques are:–

1. All men are born free, politically equal, and good, and in the "state of nature" remain so; consequently it is their natural right to be free, equal, and (presumably, their duty to be) good.[10]

2. All men being equal by natural right, none can have any right to encroach on another's equal right. Hence no man can appropriate any part of the common means of subsistence–that is to say, the land or anything which the land produces–without the unanimous consent of all other men. Under any other circumstances, property is usurpation, or, in plain terms, robbery.[11]

3. Political rights, therefore, are based upon contract; the so-called right of conquest is no [305] right, and property which has been acquired by force may rightly be taken away by force.[12]

I am bound to confess, at the outset, that, while quite open to conviction, I incline to think that the obvious practical consequences of these propositions are not likely to conduce to the welfare of society, and that they are certain to prove as injurious to the poor as to the rich. Due allowance must be made for the possible influence of such prejudice as may flow from this opinion upon my further conviction that, regarded from a purely theoretical and scientific point of view, they are so plainly and demonstrably false that, except for the gravity of their practical consequences, they would be ridiculous.

What is the meaning of the famous phrase that "all men are born free and equal," which gallicised Americans, who were as much "philosophes" as their inherited common sense and their practical acquaintance with men and with affairs would let them be, put forth as the foundation of the "Declaration of Independence"? I have seen a consid[306]erable number of new-born infants. Without wishing to speak of them with the least disrespect–a thing no man can do, without, as the proverb says, "fouling his own nest."–I fail to understand how they can be affirmed to have any political qualities at all. How can it be said that these poor little mortals who have not even the capacity to kick to any definite end, nor indeed to do anything but vaguely squirm and squall, are equal politically, except as all zeros may be said to be equal? How can little creatures be said to be "free" of whom not one would live for four and twenty hours if it were not imprisoned by kindly hands and coerced into applying its foolish wandering mouth to the breast it could never find for itself? How is the being whose brain is still too pulpy to hold an idea of any description to be a moral agent either good or bad? Surely it must be a joke, and rather a cynical one too, to talk of the political status of a new-born child? But we may carry our questions a step further. If it is mere abracadabra to speak of men being born in a state of political freedom and equality, thus fallaciously confusing positive equality–that is to say, the equality of powers–with the equality of impotences; in what conceivable state of society is it possible that men should not merely be born, but pass through childhood and still remain free? Has a child of fourteen been free to choose its language and all the connotations with which [307] words became burdened in their use by generation after generation? Has it been free to choose the habits enforced by precept and more surely driven home by example? Has it been free to invent its own standard of right and wrong? Or rather, has it not been as much held in bondage by its surroundings and driven hither and thither by the scourge of opinion, as a veritable slave, although the fetters and the whip may be invisible and intangible?

Surely, Aristotle was much nearer the truth in this matter than Hobbes or Rousseau. And if the predicate "born slave" would more nearly agree with fact than "born free," what is to be said about "born equal"? Rousseau, like the sentimental rhetorician that he was, and half, or more than half, sham, as all sentimental rhetoricians are, sagaciously fought shy, as we have seen, of the question of the influence of natural upon political equality. But those of us who do not care for sentiment and do care for truth may not evade the consideration of that which is really the key of the position. If Rousseau, instead of letting his children go to the *enfants trouvés,* had taken the trouble to discharge a father's duties towards them, he would hardly have talked so fast about men being born equal, even in a political sense. For, if that merely means that all new-born children are political zeros–it is, as we have seen, though true enough, nothing to the [308] purpose; while, if it means that, in their potentiality of becoming factors in any social organisation–citizens in Rousseau's sense–all men are born equal, it is probably the most astounding falsity that ever was put forth by a political speculator; and that, as all students of political speculation will agree, is saying a good deal for it. In fact, nothing is more remarkable than the wide inequality which children, even of the same family, exhibit, as soon as the mental and moral qualities begin to manifest themselves; which is earlier than most people fancy. Every family spontaneously becomes a polity. Among the children, there are some who continue to be "more honoured and more powerful than the rest, and to make themselves obeyed" (sometimes, indeed, by their elders) in virtue of nothing but their moral and mental qualities. Here, "political inequality" visibly dogs the heels of "natural" inequality. The group of children becomes a political body, a *civitas,* with its rights of

property, and its practical distinctions of rank and power. And all this comes about neither by force nor by fraud, but as the necessary consequence of the innate inequalities of capability.

Thus men are certainly not born free and equal in natural qualities; when they are born, the predicates "free" and "equal" in the political sense are not applicable to them; and as they develop year by year, the differences in the political [309] potentialities with which they really are born, become more and more obviously converted into actual differences–the inequality of political faculty shows itself to be a necessary consequence of the inequality of natural faculty. It is probably true that the earliest men were nomads. But among a body of naked wandering savages, though there may be no verbally recognised distinctions of rank or office, superior strength and cunning confer authority of a more valid kind than that secured by Acts of Parliament; there may be no property in things, but the witless man will be poverty-stricken in ideas, the clever man will be a capitalist in that same commodity, which in the long run buys all other commodities; one will miss opportunities, the other will make them; and, proclaim human equality as loudly as you like, Witless will serve his brother. So long as men are men and society is society, human equality will be a dream; and the assumption that it does exist is as untrue in fact as it sets the mark of impracticability on every theory of what ought to be, which starts from it.

And that last remark suggests that there is another way of regarding Rousseau's speculations. It may be pointed out that, after all, whatever estimate we may form of him, the author of works which have made such a noise in the world could not have been a mere fool; and that, if, in their plain and obvious sense, the doctrines which he [309] advanced are so easily upset, it is probable that he had in his mind something which is different from that sense.

I am a good deal disposed to think that this is the case. There is much to be said in favour of the view that Rousseau, having got hold of a plausible hypothesis, more or less unconsciously made up a clothing of imaginary facts to hide its real nakedness. He was not the first nor the last philosopher to perform this feat.

As soon as men began to think about political problems, it must have struck them that, if the main object of society was the welfare of its members (and until this became clear, political action could not have risen above the level of instinct[13]), there were all sorts of distinctions among men, and burdens laid upon them, which nowise contributed [311] to that end. Even before the great leveller, Rome, had actually thrown down innumerable social and national party-walls, had absorbed all other forms of citizenship into her own, and brought the inhabitants of what was then known as the world under one system of obligations–thoughtful men were discovering that it was desirable, in the interests of society, that all men should be as free as possible, consistently with those interests; and that they should all be equally bound by the ethical and legal obligations which are essential to social existence. It will be observed that this conclusion is one which might be arrived at by observation and induction from the phenomena of past and present experience. My belief is that it is the conclusion which must be reached by those means, when they are rightly employed–and that, in point of fact, the doctrines of freedom and equality, so far as they were preached by the Stoics and others, would have had not the least success, if they had not been so far approved by experience and so far in harmony with human instincts, that the Roman jurists

found they could work them up with effect into practical legislation. For the *a priori* arguments of the philosophers in the last century of the Republic, and the first of the Empire, stand examination no better than those of the philosophers in the centuries before and after the French Revolution. As is the fashion of speculators, they scorned to remain on [312] the safe, if humble, ground of experience, and preferred to prophesy from the sublime cloudland of the *a priori;* so that, busied with deduction from their ideal "ought to be" they overlooked the "what has been," the "what is," and the "what can be."

It is to them that we owe the idea of living "according to nature"; which begot the idea of the "state of nature"; which begot the notion that the "state of nature" was a reality, and that, once upon a time, "all men were free and equal"–which again begot the theory, that society ought to be reformed in such a manner as to bring back these halcyon days of freedom and equality; which begot *laissez faire* and universal suffrage; which begot the theory so dear to young men of more ambition than industry, that, while every other trade, business, or profession requires theoretical training and practical skill, and would go to the dogs if those who carry them on were appointed by the majority of votes of people who know nothing about it and very little about them–the management of the affairs of society will be perfectly successful, if only the people who may be trusted to know nothing, will vote into office the people who may be trusted to do nothing.

If this is the political ideal of the modern followers of Rousseau, I, for my part, object to strive after it, or to do anything but oppose, to the best of my ability, those who would fain drive us that way. Freedom, used foolishly, and equality, [313] asserted in words, but every moment denied by the facts of nature, are things of which, as it seems to me, we have rather too much already. If I mistake not, one thing we need to learn is the necessity of limiting individual freedom for the general good; and another, that, although decision by a majority of votes may be as good a rough-and-ready way as can be devised to get political questions settled, yet that, theoretically, the despotism of a majority is as little justifiable and as dangerous as that of one man; and yet another, that voting power, as a means of giving effect to opinion, is more likely to prove a curse than a blessing to the voters, unless that opinion is the result of a sound judgment operating upon sound knowledge. Some experience of sea-life leads me to think that I should be very sorry to find myself on board a ship in which the voices of the cook and the loblolly boys counted for as much as those of the officers, upon a question of steering, or reefing topsails; or where the "great heart" of the crew was called upon to settle the ship's course. And there is no sea more dangerous than the ocean of practical politics–none in which there is more need of good pilotage and of a single, unfaltering purpose when the waves rise high.

The conclusion of the whole matter, then, would seem to be that the doctrine that all men are, in any sense, or have been, at any time, free and equal, is an utterly baseless fiction. Nor does the [314] proposition fare much better if we modify it, so as to say that all men ought to be free and equal, so long as the "ought" poses as a command of immutable morality. For, assuredly, it is not intuitively certain "that all men ought to be free and equal." Therefore, if it is to be justified at all *a priori,* it must be educible from some proposition which is intuitively certain; and unfortunately none is forthcoming. For the proposition that men ought to be free to do what they please, so long as they do not infringe on the equal rights of other men, assumes that men have equal rights and cannot be used to prove that assumption. And if, instead of appealing to philosophy we turn to revealed religion, I am not aware that

either Judaism or Christianity affirms the political freedom or the political equality of men in Rousseau's sense. They affirm the equality of men before God–but that is an equality either of insignificance or of imperfection.

With the demonstration that men are not all equal under whatever aspect they are contemplated, and that the assumption that they ought to be considered equal has no sort of *a priori* foundation–however much it may, in reference to positive law, with due limitations, be justifiable by considerations of practical expediency–the bottom of Rousseau's argument, from *a priori* ethical assumptions to the denial of the right of an individual to hold private property, falls out. For Rousseau, with more [315] logical consistency than some of those who have come after him, puts the land and its produce upon the same footing. "Vous êtes perdus si vous oubliez que les fruits sont à tous, et que la terre n'est à personne," says he.[14]

From Rousseau's point of view (and, for the present, I leave any other aside), this is, in fact, the only rational conclusion from the premisses. The attempt to draw a distinction between land, as a limited commodity, and other things as unlimited, is an obvious fallacy. For, according to him,[15] the total habitable surface of the earth is the property of the whole human race in common. Undoubtedly, the habitable and cultivable land amounts to a definite number of square miles, which, by no effort of human ingenuity, at present known or suspected, can be sensibly increased beyond the area of that part of the globe which is not covered by water; and therefore its quantity is limited. But if the land is limited, so is the quantity of the trees that will grow on it; of the cattle that can be pastured on it; of the crops that can be raised from it; of the minerals that can be dug from it; of the wind and of the water-power, afforded by the limited streams which flow from the limited heights. And, if the human race were to go on increasing in number at its present rate, a time would come when there would not be stand [316]ing ground for any more; if it were not that, long before that time, they would have eaten up the limited quantity of food-stuffs and died like the locusts that have consumed everything eatable in an oasis of the desert. The attempt to draw a distinction between land as limited in quantity, in the sense, I suppose, that it is something that cannot be imported–and other things as unlimited, because they can be imported–has arisen from the fact that Rousseau's modern followers entertain the delusion that, consistently with their principles, it is possible to suppose that a nation has right of ownership in the land it occupies. If the island of Great Britain is the property of the British nation, then, of course, it is true that Britons cannot have more than somewhere about 90,000 square miles of land, while the quantity of other things they can import is (for the present, at any rate), practically, if not strictly, unlimited. But how is the assumption that the Britons own Britain, to be reconciled with the great dictum of Rousseau, that a man cannot rightfully appropriate any part of this limited commodity, land, without the unanimous consent of all his fellow men? My strong impression is that if a parti-coloured plebiscite of Europeans, Chinese, Hindoos, Negroes, Red Indians, Maoris, and all the other inhabitants of the terrestrial globe were to decree us to be usurpers, not a soul would budge; and that, if it came to fighting. Mr. Morley's late "hecklers" might be safely [317] depended upon to hold their native soil against all intruders, and in the teeth of the most absolute of ethical politicians, even though he should prove from Rousseau,

"Exceedingly well

That such conduct was quite atrocious."

Rousseau's first and second great doctrines having thus collapsed, what is to be said to the third?

Of course, if there are no rights of property but those based on contract, conquest, that is to say, taking possession by force, of itself can confer no right. But, as the doctrine that there are no rights of property but those based on the consent of the whole human race–that is, that A. B. cannot own anything unless the whole of mankind formally signify their assent to his ownership–turns out to be more than doubtful in theory and decidedly inconvenient in practice, we may inquire if there is any better reason for the assertion that force can confer no right of ownership. Suppose that in the old seafaring days, a pirate attacked an East Indiaman–got soundly beaten and had to surrender. When the pirates had walked the plank or been hanged, had the captain and crew of the East Indiaman no right of property in the prize–I am not speaking of mere legal right, but ethically? But if they had, what is the difference when nations attack one another; when there is no way out of their quarrel but the appeal to force, and the one [318] that gets the better seizes more or less of the other's territory and demands it as the price of peace? In the latter case, in fact, we have a contract, a price paid for an article–to wit peace–delivered, and certain lands taken in exchange; and there can be no question that the buyer's title is based on contract. Even in the former alternative, I see little difference. When they declared war, the parties knew very well that they referred their case to the arbitrament of force; and if contracts are eternally valid, they are fully bound to abide by the decision of the arbitrator whom they have elected to obey. Therefore, even on Hobbes's or Rousseau's principles, it is not by any means clear to my mind that force, or rather the state of express or tacit contract which follows upon force, successfully applied, may not be plausibly considered to confer ownership.

But if the question is argued, as I think it ought to be, on empirical grounds–if the real question is not one of imagined *a priori* principle, but of practical expediency–of the conduct which conduces most to human welfare–then it appears to me that there is much to be said for the opinion that force effectually and thoroughly used, so as to render further opposition hopeless, establishes an ownership[16] which should be recog[319]nised as soon as possible. I am greatly disposed to think, that when ownership established by force has endured for many generations, and all sorts of contracts have been entered into on the faith of such ownership, the attempt to disturb it is very much to be deprecated on all grounds. For the welfare of society, as for that of individual men, it is surely essential that there should be a statute of limitations in respect of the consequences of wrong-doing. As there is nothing more fatal to nobility of personal character than the nursing of the feeling of revenge–nothing that more clearly indicates a barbarous state of society than the carrying on of a *vendetta*, generation after generation, so I take it to be a plain maxim of that political ethic which does not profess to have any greater authority than agreeableness to good feeling and good sense can confer, that the evil deeds of former generations–especially if they were in accordance with the practices of a less advanced civilisation, and had the sanction of a less refined morality–should, as speedily as possible, be forgotten and buried under better things.

"Musst immer thun wie neu geboren" is the best of all maxims for the guidance of the life of States, no

less than of individuals. However, I express what I personally think, in all humility, in the face of the too patent fact, that there are persons of light and leading–with a political [320] authority to which I can make not the remotest pretension, and with a weight of political responsibility which I rejoice to think can never rest on my shoulders–who by no means share my opinion, but who, on the contrary, deem it right to fan the sparks of revenge which linger among the embers of ancient discords; and to stand between the dead past and the living present, not with the healing purpose of the Jewish leader, but rather to intensify the plague of political strife, and hold aloft the brazen image of the father's wrongs, lest the children might perchance forget and forgive.

However, the question whether the fact that property in land was originally acquired by force invalidates all subsequent dealings in that property so completely, that no lapse of time, no formal legalisation, no passing from hand to hand by free contract through an endless series of owners, can extinguish the right of the nation to take it away by force from the latest proprietor, has rather an academic than a practical interest, so long as the evidence that landed ownership did so arise is wanting. Potent an organon as the *a priori* method may be, its employment in the region of history has rarely been found to yield satisfactory results; and, in this particular case, the confident assertions that land was originally held in common by the whole nation, and that it has been con[321]verted into severalty by force, as the outcome of the military spirit rather than by the consent, or contract, characteristic of industrialism, are singularly ill-founded.

Let us see what genuine history has to say to these assertions. Perhaps it might have been pardonable in Rousseau to propound such a statement as that the primitive landowner was either a robber or a cheat; but, in the course of the century and a half which has elapsed since he wrote, and especially in that of the last fifty years, an immense amount of information on the subject of ancient land-tenure has come to light; so that it is no longer pardonable, in any one, to content himself with Rousseau's ignorance. Even a superficial glance over the results of modern investigations into anthropology, archæology, ancient law and ancient religion, suffices to show that there is not a particle of evidence that men ever existed in Rousseau's state of nature, and that there are very strong reasons for thinking that they never could have done so, and never will do so.

It is, at the least, highly probable that the nomadic preceded any other social state; and, as the needs of a wandering hunter's or pastor's life are far more simple than any other, it follows that the inequalities of condition must be less obvious among nomads than among settled people. Men who have no costume at all, for example, cannot be said to be unequally clothed; they are, doub[322]tless, more equal than men some of whom are well clothed and others in rags, though the equality is of the negative sort. But it is a profound mistake to imagine that, in the nomadic condition, any more than in any other which has yet been observed, men are either "free" or "equal" in Rousseau's sense. I can call to mind no nomadic nation in which women are on an equality with men; nor any in which young men are on the same footing as old men; nor any in which family groups, bound together by blood ties, by their mutual responsibility for bloodshed and by common worship, do not constitute corporate political units, in the sense of the city[17] of the Greeks and Romans. A "state of nature" in which noble and peaceful, but nude and propertyless, savages sit in solitary meditation under trees, unless they are dining or amusing

themselves in other ways, without cares or responsibilities of any sort, is simply another figment of the unscientific imagination. The only uncivilised men of whom anything is really known are hampered by superstitions and enslaved by conventions, as strange as those of the most artificial societies, to an almost incredible degree. Furthermore, I think it may be said with much confidence that the primitive "land-[323]grabber" did not either force or cheat his coproprietors into letting him fence in a bit of the land which hitherto was the property of all.

The truth is we do not know, and, probably, never shall know completely, the nature of all the various processes by which the ownership of land was originally brought about. But there is excellent ground for sundry probable conclusions[18] in the fact that almost all parts of the world, and almost all nations, have yielded evidence that, in the earliest settled condition we can get at, land was held as private or several property, and not as the property of the public, or general body of the nation. Now private or several property may be held in one of two ways. The ownership may be vested in a single individual person, in the ordinary sense of that word; or it may be vested in two or more individuals forming a corporation or legal person; that is to say, an entity which has all the duties and responsibilities of an individual person, but is composed of two or more individuals. It is obvious that all the arguments which Rousseau uses against individual landownership apply to corporate landownership. If the rights of A, B, and C are individually *nil,* you cannot make any more of your 0 by multiplying it by three. (A B C)–the corporation–must be [324] an usurper if A, B, and C taken each by himself is so. Moreover, I think I may take it for granted that those who desire to make the State universal landowner, would eject a corporation from its estates with even less hesitation than they would expel an individual.

The particular method of early landholding of which we have the most widespread traces is that in which each of a great number of moderate-sized portions of the whole territory occupied by a nation is held in complete and inalienable[19] ownership by the males of a family, or of a small number of actual or supposed kindred families, mutually responsible in blood feuds, and worshipping the same God or Gods. No female had any share in the ownership of the land. If she married outside the community she might take a share of the moveables; and, as a rule, she went to her husband's community. If, however, the community was short of hands, the husband might be taken into it, and then he acquired all the rights and responsibilities of the other members. Children born in the community became full members of it by domicile, so to speak, not by heredity from their parents. This primitive "city" was lodged in one or more dwellings, each usually standing in a patch of inclosed ground; of arable land in the immediate neighbourhood of the [324] dwellings; while pasture and uncleared forest land lay outside all. Each commune was as jealous of its rights of ownership as the touchiest of squires; but, so long as the population was as scanty in proportion to the occupied territory, as was usually the case in ancient times, the communities got along pretty peaceably with one another. Any notion that all the communities which made up the nation had a sort of corporate overlordship over any one, still more that all the rest of the world had any right to complain of their "appropriation of the means of subsistence," most assuredly never entered the heads of our forefathers. But, alongside this corporate several ownership, there is strong ground for the belief that individual ownership was recognised, to a certain extent, even in these early times. The inclosure around each dwelling was understood to belong to the family inhabiting the dwelling; and, for all practical purposes, must have been as much owned by the head of it as a modern

entailed estate is owned by the possessor for the time being. Moreover, if any member of the community chose to go outside and clear and cultivate some of the waste, the reclaimed land was thenceforth recognised as his, that is to say, the right of ownership, in virtue of labour spent, was admitted.[20]

[326] Thus it is obvious that, though the early landholders were, to a great extent, collective owners, the imaginary rights of mankind to universal landownership, or even of that of the nation at large to the whole territory occupied, were utterly ignored; that, so far from several ownership being the result of force or fraud, it was the system established with universal assent; and that, from the first, in all probability, individual rights of property, under certain conditions, were fully recognised and respected. Rousseau was, therefore, correct in suspecting that his "state of nature" had never existed–it never did, nor anything like it. But it may be said, supposing that all this is true, and supposing that the doctrine that Englishmen have no right to their appropriation of English soil is nonsense; it must, nevertheless, be admitted that, at one time, the great body of the nation, consisting of these numerous landowning corporations, composed of comparatively poor men, did own the land. And it must also be admitted that now they do not; but that the land is in the hands of a relatively small number of actually or comparatively rich proprietors, who constitute perhaps not one per cent. of the population. What is this but the result of robbery and cheating? The descendants of the robbers and cut-throat soldiers who came over with William of Normandy, have been true to their military instincts, and have "conveyed" the [327] property of the primitive corporations into their own possession. No doubt, that is history made easy; but here, once more, fact and *a priori* speculations cannot be made to fit.

Let us look at the case dispassionately, and by the light of real history. No doubt, the early system of land tenure by collective several ownership was excellently adapted to the circumstances in which mankind found themselves. If it had not been so, it would not have endured so long, nor would it have been adopted by all sorts of different races–from the ancient Irish to the Hindoos, and from the Russians to the Kaffirs and Japanese. These circumstances were in the main as follows: That there was plenty of land unoccupied; that population was very scanty and increased slowly; that wants were simple; that people were content to go on living in the same way, generation after generation; that there was no commerce worth speaking of; that manufactures were really that which they are etymologically–things made by the hands; and that there was no need of capital in the shape of money. Moreover, with such methods of warfare as then existed, the system was good for defence, and not bad for offence.

Yet, even if left to itself, to develop undisturbedly, without the intrusion of force, fraud or militarism in any shape, the communal system, like the individual-owner system or the State-[3280]owner system, or any other system that the wit of man has yet devised, would sooner or later have had to face the everlasting agrarian difficulty. And the more the communities enjoyed general health, peace, and plenty, the sooner would the pressure of population upon the means of support make itself felt. The difficulty paraded by the opponents of individual ownership, that, by the extension of the private appropriation of the means of subsistence, the time would arrive when men would come into the world for whom there was no place, must needs make its appearance under any system, unless mankind are prevented from multiplying indefinitely. For, even if the habitable land is the property of the whole human race the multiplication of that race must, as we have seen, sooner or later, bring its numbers up to the maximum

which the produce can support; and then the interesting problem in casuistry, which even absolute political ethics may find puzzling, will arise: Are we, who can just exist, bound to admit the newcomers who will simply starve themselves and us? If the rule that any one may exercise his freedom only so far as he does not interfere with the freedom of others is all-sufficient, it is clear that the newcomers will have no rights to exist at all, inasmuch as they will interfere most seriously with the freedom of their predecessors. The population question is the real riddle of the sphinx, to which no political Œdipus has as [329] yet found the answer. In view of the ravages of the terrible monster, over-multiplication, all other riddles sink into insignificance.

But to return to the question of the manner in which individual several ownership has, in our own and some other countries, superseded communal several ownership. There is an exceedingly instructive chapter in M. de Laveleye's well-known work on "Primitive Property," entitled "The Origin of Inequality in Landed Property." And I select M. de Laveleye as a witness the more willingly, because he draws very different conclusions from the facts he so carefully adduces to those which they appear to me to support.

After enumerating various countries in which, as M. de Laveleye thinks, inequality and an aristocracy were the result of conquest, he asks very pertinently–

"But how were they developed in such countries as Germany, which know nothing of conquerors coming to create a privileged caste above a vanquished and enslaved population? Originally we see in Germany associations of free and independent peasants like the inhabitants of Uri, Schwyz, and Unterwalden at the present day. At the close of the middle ages we find, in the same country, a feudal aristocracy resting more heavily on the soil, and a rustic population more completely enslaved than in England, Italy, or France" (p. 222).

The author proceeds to answer the question which he propounds by showing, in the first place, that the admission of the right of individuals and their heirs to the land they had reclaimed, which [330] was so general, if not universal, created hereditary individual property alongside the communal property, so that private estates arose in the waste between the sparse communal estates. Now, it was not every family or member of a community that was enterprising enough to go out and clear waste lands, or that had the courage to defend its possessions when once obtained. The originally small size of the domains thus acquired, and the strong stimulus of personal interest, led to the introduction of better methods of cultivation than those traditional in the communes. And, finally, as the private owner got little or no benefit from the community, he was exempted from the charges and *corvées* laid upon its members. The result, as may be imagined, was that the private proprietors, aided by serf-labour, prospered more than the communities cultivated by their free members, seriously hampered them by occupying fresh waste lands, yielded more produce, and furnished wealth, which, with the help of the *majorat* system, remained concentrated in the hands of owners who, in virtue of their possessions, could maintain retainers; while, freed from the need to labour, they could occupy themselves with war and the chase, and, as nobles, attend the sovereign. On the other hand, their brethren, left behind in the communes, had little chance of growing individually rich or powerful, and had to give themselves up to [331] agricultural toil. The Bishop of Oxford, in his well-known "Constitutional History of England" (vol. i., p. 51), puts the case, as his wont is, concisely and precisely: "As the population increased, and

agriculture itself improved, the mark system must have been superseded everywhere." No doubt, when the nobles had once established themselves, they often added force and fraud to their other means of enlarging their borders. But, to begin with, the inequality was the result, not of militarism, but of industrialism. Clearing a piece of land for the purpose of cultivating it and reaping the crops for one's own advantage is surely an industrial operation, if ever there was one.

Secondly, M. de Laveleye points out that the Church was a great devourer of commune lands:–

"We know that a member of the commune could only dispose of his share with the consent of his associates, who had a right of resumption; but this right could not be exercised against the Church. Accordingly, in these days of religious fervour, the faithful frequently left to the Church all that they possessed, not only their house and its inclosure, but the undivided share in the *mark* attached to it" (p. 225). Thus an abbot, or a bishop, became co-proprietor with the peasants of a commune; and, with such a cuckoo in the nest, one can conceive that the hedge-sparrows might have a bad time. "Already [332] by the end of the ninth century one-third of the whole soil of Gaul belonged to the clergy" (p. 225). But, if the men who left their property to the Church believed that they got their *quid pro quo* in the shape of masses for their souls, as they certainly did; and if the Churchmen believed as sincerely (and they certainly did) that they gave valuable consideration for the property left them, where does fraud come in? Is it not again a truly industrial operation? Indeed, a keenwitted and eminent Scotch judge once called a huge bequest to a Church "fire insurance," so emphatically commercial did the transaction appeal to him

Thirdly, personal several property was carved out of the corporate communal property in another fashion, to which no objection can be taken by industrialism. Plots of arable land were granted to members of the commune who were skilled artificers, as a salary for their services. The craft transmitting itself from father to son the land went with it and grew into an hereditary benefice.

Fourthly, Sir Henry Maine[21] has proved in a very striking manner, from the collection of the Brehon Laws of ancient Ireland, how the original communal landownership of the sept, with the allotment of an extra allowance of pasture to the chief, as the honorarium for his services of all [333] kinds, became modified, in consequence of the power of keeping more cattle than the rest of the sept, thus conferred on the chief. He became a lender of cattle at a high rate of interest to his more needy sept-fellows, who when they borrowed became bound to do him service in other ways and lost status by falling into the position of his debtors. Hence the chief gradually acquired the characteristics of what naturalists have called "synthetic" and "prophetic" types, combining the features of the modern gombeen-man with those of the modern rack-renting landlord, who is commonly supposed to be a purely imported Norman or Saxon product, saturated with the very spirit of industrialism–namely, the determination to get the highest price for an article which is to be had. As a fact, the condition of the native Irish, under their own chiefs, was as bad in Queen Elizabeth's time as it has ever been since. Again, the status of the original commoners of the sept was steadily altered for the worse by the privilege which the chief possessed, and of which he freely availed himself, of settling on the waste land of the commune such broken vagabonds of other tribes as sought his patronage and protection, and who became absolutely dependent upon him.

Thus, without war and without any necessity for force or fraud (though doubtless there was an adventitious abundance of both), the communal system was bound to go to pieces, and [334] to be replaced by individual ownership, in consequence of the operation of purely industrial causes. That is to say, in consequence of the many commercial advantages of individual ownership over communal ownership; which became more and more marked exactly in proportion as territory became more fully occupied, security of possession increased, and the chances of the success of individual enterprise and skill as against routine, in an industrial occupation, became greater and greater.

The notion that all individual ownership of land is the result of force and fraud appears to me to be on a level with the peculiarly short-sighted prejudice that all religions are the results of sacerdotal cunning and imposture. As religions are the inevitable products of the human mind, which generates the priest and the prophet as much as it generates the faithful; so the inequality of individual ownership has grown out of the relative equality of communal ownership in virtue of those natural inequalities of men, which, if unimpeded by circumstances, cannot fail to give. rise quietly and peaceably to corresponding political inequalities.

The task I have set myself is completed, as far as it can be within reasonable limits. I trust that those who have taken the trouble to follow the argument, will agree with me that the gospel [335] of Jean Jacques, in its relation to property, is a very sorry affair–that it is the product of an untrustworthy method, applied to assumptions which are devoid of foundation in fact; and that nothing can be more profoundly true than the saying of the great and truly philosophical English jurist, whose recent death we all deplore, that speculations of this sort are rooted in "impatience of experience and the preference of *a priori* to all other methods of reasoning."

Almost all the multitudinous causes which concurred in bringing about the French Revolution are happily absent in this country; and I have not the slightest fear that the preaching of any amount of political fallacy will involve us in evils of the magnitude of those which accompanied that great drama. But, seeing how great and manifold are the inevitable sufferings of men; how profoundly important it is that all should give their best will and devote their best intelligence to the alleviation of those sufferings which can be diminished, by seeking out, and, as far as lies within human power, removing their causes; it is surely lamentable that they should be drawn away by speculative chimæras from the attempt to find that narrow path which for nations, as for individual men, is the sole road to permanent well-being.

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[1] In his famous work on *Ancient Law* the late Sir Henry Maine has remarked, with great justice, that Rousseau's philosophy "still possesses singular fascination for the looser thinkers of every country;" that "it helped most powerfully to bring about the grosser disappointments of which the first French Revolution was fertile," and that "it gave birth, or intense stimulus, to the vices of mental habit all but universal at the time, disdain of positive law, impatience of experience, and the preference of *a priori* to all other reasoning" (pp. 89-92). I shall often have to quote *Ancient Law*. The first edition of this admirable book was published in 1861, but now, after twenty-nine years of growing influence on thoughtful men, it seems to be forgotten, or wilfully ignored, by the rack of political speculators. It is enough to make one despair of the future that Demos and the Bourbons seem to be

much alike in their want of capacity for either learning or forgetting.

[2] Those who desire to do so with ease and pleasure should read M. Rocquain's *L'Esprit revolutionnaire en France avant la Révolution.* It is really a luminous book, which ought to be translated for the benefit of our rising public men, who, having had the advantage of a public school education, are so often unable to read French with comfort. For deeper students there is, of course, the great work of M. Taine, *Les Origines de la France contemporaine.*

[3] Sir H. Maine observes that the "strictly juridical axiom" of the lawyers of the Antonine era ("omnes homines naturâ æquales sunt"), after passing through the hands of Rousseau and being adopted by the founders of the Constitution of United States, returned to France endowed with vastly greater energy and dignity, and that "of all 'the principles of 1789' it is the one which has been least strenuously assailed, which has most thoroughly leavened modern opinion, and which promises to modify most deeply the constitution of societies, and the politics of States" (*Ancient Law*, p. 96).

[4] If I had not reason to think that Mr. Morley's Rousseau and Sir Henry Maine's *Ancient Law,* especially the admirable chapters III. and IV., must be unknown to many political writers and speakers, and *a fortiori* to the general public, there would be no excuse for the present essay, which simply restates the case which they have so exhaustively treated.

[5] From Mr. Herbert Spencer's letter in the *Times* of the 27th of November, 1889, I gather that he altogether repudiates the doctrines which I am about to criticise. I rejoice to hear it; in the first place, because they thus lose the shelter of his high authority; secondly, because, after this repudiation, anything I may say in the course of the following pages against Rousseauism cannot be disagreeable to him; and, thirdly, because I desire to express my great regret that, in however good company, I should have lacked the intelligence to perceive that Mr. Spencer had previously repudiated the views attributed to him by the land socialists. May I take this opportunity of informing the many correspondents who usually favour me with comments (mostly adverse, I am sorry to say) on what I venture to write, that I have no other answer to give them but Pilate's: "What I have written I have written"? I have no energy to waste on replies to irresponsible criticism.

[6] Compare *Ancient Law*.–"The Law of Nature confused the Past and the Present. Logically, it implied a state of Nature which had once been regulated by Natural Law; yet the jurisconsults do not speak clearly or confidently of the existence of such a state" (p. 73). "There are some writers on the subject who attempt to evade the fundamental difficulty by contending that the code of Nature exists in the future and is the goal to which all civil laws are moving" (p. 74). The jurisconsults conceived of Natural Law "as a system which ought gradually to absorb Civil Laws" (p. 76). "Its functions were, in short, remedial, not revolutionary or anarchical. And this unfortunately is the exact point at which the modern view of a Law of Nature has often ceased to resemble the ancient" (p. 77).

[7] In the course of the correspondence in the *Times* to which I have referred, I was earnestly exhorted to believe that the world of politics does not lie outside of the province of science. My impression is that I was trying to teach the public that great truth, which I had learned from Mill and Comte, thirty-five years ago, when, if I mistake not my well-meaning monitor was more occupied with peg-tops than with politics. See a lecture on the "Educational Value of the Natural History Sciences" delivered in 1854 (*Lay Sermons*, p. 97).

[8] The publication of Buffon's *Histoire Naturelle* began in 1749. Thus Rousseau was indebted to the naturalists; on the other hand, in the case of the elder Darwin, who started what is now usually known as Lamarck's hypothesis, the naturalist was set speculating by the ideas of the philosopher Hartley, transmitted through Priestley. See *Zoonomia*, I. sect. xxxix. p. 483 (ed. 1796). I hope some day to deal at length with this curious fact in scientific history.

[9] *Contract Social*, livre 1er.–Compare Hobbes' dedication of Human Nature written in 1640:–"They who have written of justice and policy in general, do all invade each other and themselves with contradictions. To reduce this doctrine to the rules and infallibility of reason there is no way, but, first, put such principles down for a foundation, as passion, not mistrusting, may not seek to displace; and afterwards to build thereon the truth of cases in the law of Nature (which hitherto have been built in the air) by degrees, till the whole have been inexpugnable." However, it must be recollected that Hobbes does not start from *a priori* principles of ethics, but from the practical necessities of men in society.

[10] *Contrat Social*, v. pp. 98, 99. The references here given are to the volumes and pages of Mussay Pathay's edition (1826). *Discours, passim;* see especially p. 268.

[11] *Discours*, pp. 257, 258-276. How many wild sermons have been preached on this text:–"Ignorez vous qu'une multitude de vs frères périt ou souffre du besoin de ce que vous avez de trop, et qu'il vous fallait un consentement exprès et unanime du genre humain pour vous approprier sur la subsistance commune tout ce qui alloit audelâ de la vôtre?"

[12] *Discours*, pp. 276, 280. *Contrat*, chap. iii.:–"Telle fut ou dut être' (charming alternative!) "l'origine de la sociêté et des lois, qui donnèrent de nouvelles entraves au foible et de nouvelles forces au riche, détruisirent sans retour la liberté naturelle, fixérent pour jamais la loi de la propriété et de l'inégalité, d'une adroite usurpation firent un droit irrévocable, et, pour le profit de quelques ambitieux, assujettirent désormais tout le genre humain au travail, â la servitude et â la misère" (*Discours*, p. 278). Behold the quintessence of Rousseauism–method and results–with practical application, legible by the swiftest runner!

[13] It is not to be forgotten that what we call rational grounds for our beliefs are often extremely irrational attempts to justify our instinct. I cannot doubt that human society existed before language or any ethical consciousness. Gregarious animals form polities, in which they act according to rules conducive to the welfare of the whole society, although, of course, it would be absurd to say that they obey laws in the juridical sense. The polities of the masterless dogs in Eastern cities are well known. And, in any street of an English town, one may observe a small dog chased by a bigger, who turns round the moment he has entered his own territory and defies the other; while, usually after various manifestations of anger and contempt, the bigger withdraws. No doubt the small dog has had previous experience of the arrival of assistance under such circumstances, and the big one of the effects of sticks and stones and other odd missiles; no doubt, the associations thus engrained are the prime source of the practical acknowledgment of ownership on both sides. I suspect it has been very much the same among men.

[14] [Which may be Englished, in brief, "Crops are everybody's and land is nobody's."]

[15] As to Hobbes, but on different grounds.

[16] Submission to the Revolution of 1688 by Jacobites could be advocated ethically on no other ground, though all sorts of pretexts were invented to disguise the fact.

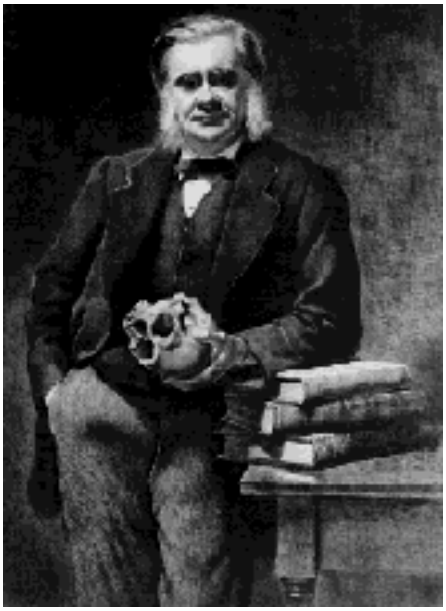
[17] I may remind the reader that, in their original senses, [polis] and *civitas* mean, not an aggregation of houses, but a corporation. In this sense, the City of London is formed by the freemen of the City, with their Common Councillors, Aldermen, and Lord Mayor

[18] For the difficulties which attach to the establishment of such probable conclusions, see the remarkable work of M. Fustel de Coulanges–*Recherches sur quelques problemes d'Histoire: Les Germains.*

[19] Inalienable, that is, without the consent of the whole owning community.

[20] Rousseau himself not only admits, but insists on the validity of this claim in the *Contrat Social*, liv. i. chap.ix.

[21] See *Early History of Institutions*, especially Lecture vi.



Right Honourable
Privy Councillor 1890

Huxley Archives

Natural Rights and Political Rights (February 1890)

Collected Essays I

[336] In looking through a series of critical notices the other day, my eye was caught by a remark upon my essay "On the Natural Inequality of Men"–to the effect that it was well enough; but why should I have taken all that trouble to slay the slain?

Evidently, the propounder of the question believes that the doctrines of that school of political philosophers of which Rousseau was the typical representative, are not only killed but dead. But, whatever may hold good of men, doctrines do not necessarily die from being killed. Many a long year ago, I fondly imagined that Hume and Kant and Hamilton having slain the "Absolute," the thing, must, in decency, decease. Yet, at the present time, the same hypostasized negation, sometimes thinly disguised under a new name, [337] goes about in broad daylight, in company with the dogmas of absolute ethics, political and other, and seems to be as lively as ever. It would seem to be to no purpose that the history of every branch of physical and historical science teems with examples of the fate which befalls the hasty generaliser who numbers, rather than weighs, supposed facts; and treats the rough approximations to truth obtained by the observation of highly complex phenomena as if they had the precision of geometrical theorems.

There is, unfortunately, abundant evidence that the vicious method of *a priori* political speculation which I have illustrated from the writings of Rousseau is not only in full vigour, but that it is exerting an influence upon the political action of our contemporaries which is extremely serious. No better evidence of the fact need be adduced than the avidity with which the writings of political teachers of this school have been and are being read, especially among the more intelligent of the working classes; and I doubt if any book published during the last ten years has obtained a larger circulation among them, not only in this country but in the United States, than "Progress and Poverty." The other day there was a rumour that some devoted disciple of its author, Mr. Henry George, had bequeathed a large sum of money to him in order to aid in the propagation of his doctrines.

In some respects, the work undoubtedly deserves the success which it has won. Clearly and vigorously written, though sometimes weakened by superfluous rhetorical confectionery, "Progress and Poverty" leaves the reader in no doubt as to Mr. George's meaning, and thus fulfils the primary condition of honest literature. Nor will any one question the author's intense conviction that the adoption of his panacea will cure the ills under which the modern state groans.

Mr. George's political philosophy is, in principle, though by no means in all its details, identical with Rousseauism. It exhibits, in perfection, the same *a priori* method, starting from highly questionable axioms which are assumed to represent absolute truth, and asking us to upset the existing arrangements of society on the faith of deductions from those axioms. The doctrine of "natural rights" is the fulcrum upon which he, like a good many other political philosophers, during the last 130 years, rests the lever wherewith the social world is to be lifted away from its present foundations and deposited upon others. In this respect, he is at one, not only with Rousseau and his conscious or unconscious followers in France and in England; but, I regret to say, may claim the countenance of a far more scientifically minded and practical school of political thinkers–that of the French *Physiocrates* of the eighteenth century.

The founder of this school, Quesnay, the saga[339]cious physician of Louis the Fifteenth, whom even that graceless prince appreciated and called his "thinker," was an eminently practical man, especially conversant with agriculture. As the name taken by his disciples implies, his teaching was, professedly, based upon careful observation of, and induction from, the course of nature, as it bears upon politics. It

would hardly be too much to say that we owe to the Physiocrates the modern clearness of conviction that the world of human society is as much the theatre of order and definite sequence of cause and effect as the world of extrahuman nature; that there are rules of action, the observance of which brings about prosperity, while their neglect entails ruin, which have nothing to do with the laws of morality or with the ordinances of religion; and that the wicked who follow these rules will not beg their bread, while the pious who neglect them will. But Quesnay and his followers would have been more than mortal if they had escaped the influence of the spirit of their age; and though they never fell into the speculative monstrosities of Rousseau, yet, about the time that the latter was occupied with his essay on "Inequality," Quesnay composed that short work entitled "Le Droit Naturel," which is all too largely infected by the *a priori* method.

Quesnay begins by laying down the proposition that "Natural Right" may be "vaguely defined" as "the right which a man has to the things [340] which are fit for his enjoyment." Truly a vague enough definition, and one that would need a great deal more defining before it could be safely turned to any practical account. Quesnay's friend and collaborateur, Dupont de Nemours, in the introductory discourse prefixed to the collection entitled "Physiocratie: ou constitution naturelle du gouvernement le plus avantageux au genre humain," published in 1768, has somewhat improved upon it. "Natural Right," he says, is "the right a man has to do that which is to his advantage." He considers that this right is founded upon the condition that we are "charged with our own preservation under penalty of suffering and death." And he adds: "The final degree of punishment decreed by this sovereign *law* is superior to every other interest and to every arbitrary law." "Natural Right," then, is the right of a man to do anything necessary for his own preservation, and to possess himself of any means of enjoyment. It is possessed to its full and literal extent by any and every wholly isolated man. "Natural Right," by this account of it, must vest in the individual before he has entered into the social state, and must be antecedent to all forms of relative justice and injustice. But the contemporaneous and contiguous existence of many such individuals, all of whom assert their natural rights, must also necessarily end in the Hobbesian state of war of each against all, unless [341] they agree to conventions which shall allow to each his natural right to things enjoyable; or, in other words, his freedom to profit by the advantages which he is competent to obtain from the order of nature.[1]

There seems to me to be a wonderful admixture of wholesome truth and of very unwholesome fiction in these propositions; and, as is not uncommon, the fiction has become popular while the truth is neglected. Indeed, Quesnay himself saw deeper than his disciple, and writes thus in the opening chapter of the treatise I have cited (Daire, p. 41):–

"He who has said that the natural right of man is a nullity has spoken truly.

He who has said that the natural right of man is the right which nature teaches to all animals has spoken truly.[2]

He who has said that the natural right of man is the right which his strength and his intelligence assure him has spoken truly.

He who has said that natural right is limited to the private interest of each man has spoken truly.

[342] He who has said that natural light is a general and sovereign law, which regulates the rights of all men, has spoken truly.

He who has said that the natural right of men is the unlimited right of all to everything has spoken truly.

He who has said that the natural right of men is a right limited by a tacit or explicit convention has spoken truly.

He who has said that natural light has nothing to do with either justice or injustice has spoken truly.[3]

He who has said that natural right is a just, decisive, and fundamental right, has spoken truly.

But none has spoken truly in relation to all cases."

What is one to make of this litany of antinomies? Quesnay himself seems to have been content to leave the riddle unanswered–while his successors do not appear to have understood that there was a riddle to answer. Each proposition may certainly be plausibly justified, and yet contradicts, or is hard to reconcile with, some other. Now, when this is the case, we may be pretty sure that the difficulty arises from some ambiguity of language. If "Natural Right" is susceptible of these opposing predicates, it must be that it stands for two or more widely different ideas. I propose to endeavour to show that this solution of the difficulty is correct.

Some time ago I fell in with an Indian tiger story of a peculiarly gruesome sort, and I repeat the substance of it, not from any especial love for [343] horrible stories, but because the tale led me, and therefore may easily lead my readers, into a train of fruitful reflections upon this very question of "Natural Rights."

A tigress carried off an unfortunate Indian villager–as a cat may carry off a mouse–without doing the man any mortal injury. Tracked to her lair in the jungle, the brute was seen to set down the half-disabled captive before her cubs, who commenced mumbling and mauling him to the best of their infantine ability, while the tender mother complacently watched their clumsy efforts to deal with the big game she had brought home. But, if the man, driven desperate, succeeded for a moment in beating off his small tormentors and crawling away a few yards, a judiciously administered grip with the thoughtful parent's strong jaws, or a cuff from her heavy and sharp-clawed paw, at once reduced the victim to a state in which the cubs could safely resume their worrying and scratching.

I suppose that no one in whose imagination these words suffice to body forth a vision of the thing will fail to be horrified at the apparently wanton infliction of such grievous mental and bodily torture upon a harmless peasant; nor think, without satisfaction, of the justice done by the rifle-shots that eventually laid the tigress and her ferocious progeny low. The assertion that the tigress had a "natural right" to do what she did, [344] or that she and her cubs were justified by the "Law of Nature" in their course of

action, will perhaps seem to most a monstrous, if not a wicked, doctrine. Yet this very doctrine is implicitly inculcated in one of the most familiar works of an author from whom the youthful mind half a century ago derived its earliest impressions of ethics; and also, unfortunately, of poetry. The young people of that day were taught to repeat:

"Let dogs delight to bark and bite,
For 'tis their nature to;
Let bears and lions growl and fight,
For God hath made them so."

As poetry, this pious doggerel is undoubtedly nought. But, as moral philosophy, ripe, nay even aged reflection must, I think, satisfy us that it is not only sound, but has the merit of putting the case in a nutshell. For, whatever tigers and tigresses may be and do, it is quite clear, if we adopt the creative hypothesis and believe that God made them, that He "made them so." The acts which we are pleased to denounce as wantonly cruel are, therefore, necessary and intentional consequences of the divine creative operation. In fact, if there is evidence of intention anywhere in the fabric of things, the study of the structure of one of the cats, great or small, will prove it to be a machine most admirably adapted to slay and tear to pieces other living [345] quadrupeds; and will demonstrate that, if it was intended to do anything, it must have been intended to perform exactly that butcher's work which it executes so well.

On the other hand, if we prefer to say no more than there is good evidence for saying, it is unquestionably true that the "nature" or innate tendency of the whole race of tigers is to prey on other large animals, men included, inasmuch as not only is their bodily and mental constitution especially fitted for that operation, but since they must perish if they fail to perform it. Tigers (as M. Dupont says of men) are charged with their own preservation under penalty of death. Moreover, when we inquire into the past history of these predaceous animals, we find that the cats, great and small, are but the last term of a long series of species of animals most of which are now extinct; which have succeeded one another through the tertiary epoch, therefore, for many thousands, or more probably millions, of years; and which, in their capacity of butchering machines, have undergone a steady though slow and gradual improvement, every step of which has been effected at the expense of an enormous total of suffering to the animals butchered. If, then, we deny that tigers have a natural right to torment and devour men, we really impeach, not the conduct of the tigers, but the order of nature. And if we ourselves, with our notions of right and [346] wrong, are, like the tigers, products of that order, whence comes our competence to deny the exercise of their natural rights to those beings who stand upon the same foundation of natural right as ourselves? To say that a thing exists in nature and to say that it has a natural right to existence are, in fact, merely two ways of stating the same truth; which is that, in nature, fact and justification of the fact, or, in other words, might and right, are coextensive. To be and to have a natural right to be, to possess a faculty and to have the natural right to exert it, are all one. Thus, it really must be admitted that the hymnologist of my childish days has reason on his side. Whether children's little hands "were made to tear each other's eyes" or not, it does not lie with us to object to tigers, any more than to dogs, or bears, or lions, growling and fighting as their natures dictate. Beyond a doubt, by the "Law of Nature," which is the foundation of "natural right," the cats and their carnivorous allies are justified.

Having thus established the "rights of tigers" to the exercise and enjoyment of the faculties with which nature has endowed them, it will be interesting to follow out the logical development of the doctrine, such as might be expected from a thoroughgoing advocate of those rights. It is admitted that a tiger has a natural right to eat a man; but if he may eat one man he may eat another, so that a tiger has a right of property in [347] all men, as potential tiger-meat. Men are as much the "gratuitous offering" of nature to tigers for their subsistence, or part subsistence, as fruits are to men. But any one tiger has no more natural right of property in men than any other tiger. All tigers are free to eat any man they can seize: and, if two tigers are sneaking along through the jungle on opposite sides of a footpath, their rights to the villager, who, travelling thereby, fondly imagines he is going home, are equal. So that we may safely enunciate the conclusion that all tigers have an equal natural right to eat all men.

I think it would be difficult to object to this argument on purely logical grounds; and the conclusions to which we are forced appear startling enough; but here we stop. If the advocate of the "rights of tigers" attempts to drive us into the further admission that, as tigers have a right to eat men, it is wrong of men to put obstacles in the way of their having their rights by refusing to be eaten, we protest against the doctrine, not on the low and selfish ground of mere personal interest, but because, however plausible, it is a patent fallacy. The champion of the "rights of tigers" has, in fact, made a convenient, though unwarrantable, jump from one sense of the word "right" to another–from "natural right" to "moral right." No doubt, he who hinders or refuses to admit a moral right is morally wrong–unjust, or, if you [348] will, wicked. But very little consideration will show that hindrance or denial of "natural rights" may not only be far from wrong, but is, in fact, a necessary consequence of the existence of such "natural rights." Grant that the tiger kills and eats men in the exercise of his natural right to preserve his own existence, and to do that for which nature has expressly fitted him; it is no less true that men kill tigers in the exercise of their equal natural right to preserve their existence. If the tiger is entitled by the law of nature to use his claws and teeth and soft-footed stealthy cleverness for the purpose of his self-preservation, the man may employ his hands and the weapons they are so admirably adapted to fabricate and wield, and use his still greater cunning, in tracking and stalking tigers to the like end.

Thus the natural rights of tigers and the natural rights of men, though quite indisputable and alike safely founded on the "Law of Nature," are diametrically opposed to one another. It follows, therefore, that they are rights to which no correlative duties correspond–rights of which the exercise may be impeded, or prevented, without the perpetration of wrong. And that is just the difference between "natural laws and rights" on the one hand, and "moral and civil laws and rights" on the other. Moral laws and civil laws are commands of an authority which may be disobeyed; but the sanctioning authority threatens [349] and visits with penalties those who disobey. "Thou shalt not steal," the negative form of the recognition of rights of property, is both a moral and a civil law. It rests on the authority either of a Deity, or on that of conscience, or on that of some civil person whose dominion is recognised; and its sanction, or penalty, incurred by disobedience, is hell, or remorse, or imprisonment, or all three.

The proper object and effect of moral and civil laws are to benefit all who are subjected to them by bringing about a state of peace and mutual confidence–the laws restraining each individual from acts which are hurtful and encouraging those which are beneficial to the polity of which he is a member. On

the contrary, the "Law of Nature" is not a command to do, or to refrain from doing, anything. It contains, in reality, nothing but a statement of that which a given being tends to do under the circumstances of its existence; and which, in the case of a living and sensitive being, it is necessitated to do, if it is to escape certain kinds of disability, pain, and ultimate dissolution. The natural right deduced from such a law of nature is simply a way of stating the fact; and there is, in the nature of things, no reason why a being possessing such and such tendencies to action should not carry them into effect. Confused with moral and civil laws and translated into the language of command, the [350] law of nature would bid the individual: "Do what you will, so far as you can." But it is only inexactly and by way of metaphor, that we can speak of disobedience to a law of nature or of penalties for such disobedience. If, by impossibility, a tiger were to have an attack of the philozoic and vegetarian fanaticism which is going about, and to declare that he would neither kill, nor eat flesh, any more, he would undoubtedly undergo a lingering and painful death by starvation. But there is neither disobedience nor penalty here. The laws of nature are statements of tendencies, and if one law expresses the truth, that tigers which kill and eat will live and wax fat, another expresses the converse truth, that if tigers do not kill and eat, they will wax lean and die. The results are consequences of two modes of action, both of which are in accordance with natural law (or they could not occur) and not rewards or penalties. Indeed, that they cannot be the latter is clear from the further truth, that the tiger who has grown old in doing his best to fulfil the first "law of nature," as with age his limbs grow stiff and his tusks wear down, falls, very much against his will, under the second "law" and dies as miserably of starvation as if he had refused to kill and eat on the loftiest of antivivisection and vegetarian principles.

The crown of the differences between the "law of nature" with its consequent "natural rights" [351] and moral or civil laws lies in this: that consistent and thoroughgoing action, based upon the law of nature and the natural rights which flow from it, tends to benefit the individual at the expense of all other individuals whose needs and desires are of the same kind; and, so far from bringing about a state of peace among such individuals, necessitates a state of war–that is to say of either conscious or unconscious competition among them. The ceaseless and pitiless "struggle for existence" which obtains throughout the whole world of living things is, in truth, the inevitable consequence of the circumstance that each living being strives knowingly, or ignorantly, to exert all its powers for the satisfaction of its needs; and asserts a tacit claim to possess (to the exclusion of other beings) all the space on the earth's surface which it can occupy and to appropriate all the subsistence which it can utilise.[4] The state of sentient nature, at any given time, is the resultant of the momentarily balanced oppositions of millions upon millions of individuals, each doing its best to get all it can and to keep what it gets; each, in short, zealously [352] obeying the law of nature and fighting tooth and nail for its natural rights. This is the *ne plus ultra* of individualism; and, wherever individualism has unchecked sway, a polity can no more exist than it can among the tigers who inhabit the same jungle. It is, in fact, the sum of all possible anti-social and anarchic tendencies.

Even among tigers (or at any rate tigresses), however, pure individualism does not always dominate. When the tigress has brought forth her cubs, and while she is nourishing, protecting, and training them, she and they enter into an association, formed of individuals held together by the attraction of the instincts which constitute the animal basis of sympathy, and thus constitute a polity, however small its scale and short its duration. And it will be observed that this most rudimentary of polities, the *family*,

could not exist without the renouncement, on the part of the tigress at least, of some of the "Rights of Tigers." The tigress no longer acts upon her natural right of eating all she kills, for example; she acts as if she were conscious of duties towards her cubs. The cubs, on the other hand, are fond and more or less obedient, acting as if they had correlative duties towards their parent. It will not be supposed, I hope, that I suggest that either tigress or cubs are capable of entertaining moral ideas; all that I desire to point out is that, partly by instinct, partly by the effects of very simple experiences, [353] both sides perform acts which a more developed intelligence symbolises by these moral ideas.

I have pointed out in the course of this discussion that among the jurists of old Rome, who first systematically developed the conceptions of the "Law of Nature" and "Natural Rights," Ulpian rightly judged that brutes came under such law and had such rights, no less than men. It is obvious that, without recurrence to that "state of nature" of mankind, of which so very much is said and so very little known, an individual man, isolated from his fellows and removed from all social relations, comes under the same law of nature; and has "natural rights" in exactly the same sense as the individual tiger possesses them. Before the advent of man Friday, Robinson Crusoe's right and might were coextensive, except in so far as he might be influenced by remembrance of the moral and civil laws of his former social existence. There was no reason why he should abstain from doing anything it pleased him to do, and which lay within the scope of his natural faculties. No one would deny that he had a natural right to take possession of his cave; to cut down the trees that suited his purpose; to gather fruits; to kill any of the wild goats for his subsistence; to shoot any number of the cannibal visitors, who would otherwise kill him for their subsistence. Crusoe's "natural rights" thus [354] potentially extended over the whole island and everything in it. According to the law of nature as defined by Quesnay, he was owner of everything therein which he desired and was able to appropriate. Suppose, however, that another wreck had simultaneously cast Will Atkins upon the opposite shore, and that Atkins had established himself there in Crusoe's fashion; then it is plain that the law of nature would confer upon him rights no less extensive. Crusoe and Atkins, stalking the same goat from opposite sides, would have been in a position identical with that of two tigers in the jungle, slinking after the same Hindoo, so far as the law of nature is concerned. And if each insisted upon exerting the whole of his natural rights, it is clear that there would be nothing for it but to fight for the goat. In the case of the men, as in that of the brutes, extreme and logical individualism means isolation and the state of war; it is plainly incompatible with the peace and co-operation which are the essentials of even temporary association. On the other hand, if the two men followed the dictates of the commonest common sense, not less than those of natural sympathy, they would at once agree to unite in peaceful co-operation with each other, for their mutual comfort and protection. And that would be possible only if each agreed to limit the exercise of his natural rights so far as they might involve any more damage to the other than to him[355]self. This is to say, the two men would, in reality, renounce the law of nature, and put themselves under a moral and civil law, replacing natural rights, which have no wrongs, for moral and civil rights, each of which has its correlative wrong. This, I take it, is the root of truth which saves the saying of Paul of Tarsus that "sin came by the law" from being a paradox. The solitary, individual man, living merely under the so-called law of nature, which cannot be violated, and having rights the contradictions of which are not wrongs, cannot sin. Wrong-doing becomes possible only when, by associating with another man, or other men, for peace and co-operation, the individual becomes implicitly, or explicitly, bound to observe certain rules of conduct in relation to him or them; any violation of these rules is a wrong.

Probably none of the political delusions which have sprung from the "natural rights" doctrine has been more mischievous than the assertion that all men have a natural right to freedom, and that those who willingly submit to any restriction of this freedom, beyond the point determined by the deductions of *a priori* philosophers, deserve the title of slave. But to my mind, this delusion is incomprehensible except as the result of the error of confounding natural with moral rights. It is undoubtedly true that a man, like a tiger or any other animal, has a natural right to freedom, if by that phrase we merely mean that, so far as he is a [356] mere individual being, there is no reason why he should not do what he pleases. But that is a very harmless proposition, and neither despot nor slaveowner need boggle at it. If, on the other hand, the champion of freedom means, as he usually does, that the natural right to freedom affords, in itself, a ground for objecting to this or that restraint upon the liberties of men who form a polity, the argument appears to me to be as sophistical as it is mischievous. For, as we have seen, it is a necessary condition of social existence that men should renounce some of their freedom of action; and the question of how much is one that can by no possibility be determined *a priori.* That which it would be tyranny to prevent in some states of society it would be madness to permit in others. The existence of a polity depends upon the adjustment of the two sets of forces which its component units, the individual men, obey–the repulsive of natural right, and the attractive and coactive of individual sympathy and corporate dominion. Which of them ought to predominate at any given time must surely depend upon external and internal circumstances and upon the degree of development of the polity. The Duke of Wellington is said to have defined martial law as "the will of the Commander-in-Chief for the time being"–that is to say, it is the sweeping away of all "rights," natural, civil, and moral, except so far as they are sanctioned by the [357] commander. Yet, surely, no one but a lunatic can maintain that, in case of invasion, or rebellion, threatening the social person–the polity–with destruction, that composite man has not as much natural right to take any measure essential to self-preservation, as an individual man has under the law of nature. And from this extreme case, to the petty question, as to whether the depositary of dominion in a polity has or has not the right to infringe the "natural right" of a man to leave the path in front of his house unswept of snow, there is an endless gradation in the importance of the problems, all of which can be solved only by the application of the same principles. Is it, or is it not, for the welfare of society at that time and under those circumstances–looking at the question all round and taking fully into account the disadvantages of restraint of liberty–that its members should be compelled to do this, or be restrained from doing that?

The political delusions which spring from the 'natural rights' doctrine are multitudinous; but I think there is only one more which is worth attention at present. That is the extraordinary notion that the logical consequence of the "natural right" of all men to any given thing is the sharing of the rights of property in that thing equally among all the claimants. Let us suppose two boys, John and Peter. I take an apple out of my pocket, and I say, "This apple is entirely yours, John; and, Peter, [358] it is also entirely yours. The whole apple belongs to each of you, and you have each a right to eat the whole of it. Now, my boys, you may eat it, so long as neither of you gives up any fraction of the right I have given him nor infringes the other's right." The boys, I take it, would be somewhat puzzled. If their common sense, *plus* their appetites, were stronger than their logical faculty, they would probably suggest that they should divide the apple and each eat half. But I should have to say "No. You are violating my conditions–which were that you should neither of you give up any portion of his right to the whole. The arrangement you

propose necessitates that John should give up his right to one half, and Peter his right to the other." Not improbably, my young friends, if of English extraction, might propose another way out of the difficulty; namely, the wager of battle. But again I should have to refuse. The trial by battle would unfortunately involve the infringement of the natural rights of the vanquished by the victor, which is, once more contrary to my stipulation. In fact; under the conditions stated, the apple would have to remain uneaten.

Thus we see once more, that the absolute "natural rights" theory–that is to say individualism pure and simple–if carried out logically is merely reasoned savagery, utter and unmitigated selfishness, incompatible with social existence. [359] And this would be obvious to every one, were it not that the ambiguous sense of the word "rights" gives a moral colour to human relations which are neither moral nor immoral, but, as Quesnay rightly says, antecedent to morality.

My readers may imagine that I have forgotten "Progress and Poverty." By no means; the preceding pages must, in fact, be regarded as a sort of "Prolegomena" to that work and especially to the first chapter of the seventh book, which contains the theoretical foundation of the practical measure which its author advocates.

According to Mr. George, society is very ill; and he proposes a method of treatment professedly based upon strict deduction from the principles of absolute political physiology. Whether the remedy is calculated to achieve the results predicted, or not, is a question I shall not now discuss; but it will be admitted that it is drastic, consisting as it does in neither more nor less than the eviction of all several landowners and the confiscation of that which is, and, for many centuries has been, regarded as their undoubted property. The measure is of exactly the same order as would be the confiscation of the interest of all money belonging to working-men in savings banks, on the ground that interest, as usury, is contrary to the principles of absolute ethics–an opinion which it must be remembered has been (perhaps still is) [360] supported by papal infallibility; which is, at least, equal in weight to the philosophical species of that commodity. Surely the medicine is a strong medicine. Now I humbly submit, that while one might take Epsom salts, on the recommendation of the first old woman who proposed that remedy for a sick headache, a rational man would like to have clearly intelligible reasons, or extremely trustworthy authority, before he ventured with an equally light heart, upon croton oil or tartar emetic. The latter might certainly put an end to his sick headache–but what if at the same time it put an end to him? So, it is at any rate possible, that the expropriation of landowners, while it might put an end to a state of things inconsistent with the principles of absolute political ethics, might also destroy the society it strove to heal. Therefore, I think we are bound to see that Mr. George's "absolute" principles are "absolutely" true before we act upon even the most logical of deductions from them. Without presumption, it may be said to be just possible that the principles may be unsound and the deductions fallacious.

In the chapter to which I have referred, the author sets out by putting the question, What constitutes the rightful basis of property? And I have conscientiously endeavoured to set forth, accurately, the essentials of his answer in the following abstract of it.

I. All men have equal rights:

[361] "The laws of nature are the decrees of the Creator. There is written in them no recognition of any right save that of labour; and in them is written broadly and clearly the equal right of all men to the use and enjoyment of Nature; to apply to her by their exertions and to receive and possess her reward. Hence, as Nature gives only to labour, the exertion of labour in production is the only title to exclusive possession." ("Progress and Poverty," 1889, p. 237.)

II. There is no foundation for any rightful title to ownership except this: That a man has a right to himself; to the use of his own powers; to the enjoyment of the fruit of his own exertions (p. 236); therefore, to whatsoever he makes or produces.

III. The right to that which is produced is "vested" in the producer by natural law (p. 236). It is also a "fundamental law of Nature that her enjoyment by man shall be consequent upon his exertion" (p. 241).

IV. Land is a gratuitous offering of Nature, not a thing produced by labour (p. 238); all men therefore have equal rights to it (p. 239). These rights are inalienable, as existing men cannot contract away the rights of their successors (p. 240). Every infant who comes into the world has as good a right to landed estates as their present possessors, by whom he is, in fact, robbed of his share (p. 240).

This, I believe, is a complete, if a succinct, statement of Mr. George's case. And I, for one, am quite prepared to admit that, if it can be [362] sustained, the sooner the foundations of our present polity are broken up and replaced by something less open to objection, the better. But even Mr. George, I imagine, will admit that the enterprise is grave, and by no means to be undertaken with a light heart, still less with that superficial intellectual apprehension which comes of a light head. The political philosopher who uses his *a priori* lever, knowing that it may stir up social discord, without the most conclusive justification, to my mind comes perilously near the boundary which divides blunders from crimes.

The several elements of the proposition which I have quoted under I. might have been taken almost *verbatim* from the writings of the Rousseauites and the Physiocrats. But it is one of the most interesting features of *a priori* speculation, that different philosophers, starting from verbally identical propositions, arrive at contradictory conclusions. And the Physiocrats deduced the right and the necessity of maintaining several ownership of land from the principles common to them and Mr. George, as confidently as, and, in my judgment, with much better reason than, Mr. George deduces its hideous wrongfulness and the paramount necessity of abolishing it. The equality of men question has already been sufficiently discussed. If, as I maintain, there is no such thing as natural equality among men, then of [363] course any argument based upon it is necessarily worthless. From the fact that men are unequal it cannot well be concluded that they have "equal rights to the use and enjoyment of nature."

Passing from this point, we are met by the broad assertion that "the exertion of labour in production is the only title to exclusive possession." So far Mr. George is at one with the Physiocrats, who also rest the claim to ownership on labour bestowed. Let us consider the grounds upon which Mr. George rests this assertion. We need not trouble ourselves whether they are the same or different from those set forth

by his predecessors.

The following questions and answers enlighten us on this head.

"What constitutes the rightful basis of property? What is it that enables a man to say justly of a thing, "It is mine"? Is it not, primarily, the right of a man to himself, to the use of his own powers, to the enjoyment of the fruits of his own exertions?" ("Progress and Poverty," p. 236.)

And, on the same page, we are told that the title to everything produced by human exertions "descends from the original producer, in whom it is vested by natural law." Here we are back again on the ground of the "law of nature" and "natural rights," according to which, as we have seen, a man has a right to keep anything he is strong enough to keep, whether he has produced it or not. But the [364] law of nature affords not the least reason why another man who is stronger should not take his possession away from him.

As I have already fully shown, there is not the least connection between the natural rights of the solitary individual and the moral or civil rights of the man who has entered into association with others. A man may justly say that it is no more than the "use of his own powers," to knock another down and rob him of his dinner; and that it is no more than "the enjoyment of the fruits of his own exertions" to proceed to eat that dinner. Is it pretended that the man who has entered into association with others retains those "natural rights"?

But let us assume, for the sake of argument, not only that labour is the "only" title to exclusive possession, but that the foundation of this title lies in the right of a man to himself; and in which is, somewhat sophistically, included the right to the use of his own powers and the enjoyment of the fruits of his own exertions. If we try to believe both these propositions at once, surely we fall into perplexities worse than any that have yet befallen us. If labour is the only title to exclusive possession; if, for example, there can be no exclusive possession of cultivated land simply and solely because, according to Mr. George, it is not a product of labour–propositions on the axiomatic certainty of which the whole fabric of "Progress and Poverty" rests–how in the world does a man [365] come by the "right to himself"? I have paid a good deal of attention to those branches of natural history which treat more especially of man, but never yet have I come across even the smallest grounds for believing that a man has ever been known to make himself, or to endow himself by his own labour with the powers he exerts. I have heard often enough of men who were said to be self-made. Indeed, I have known some cases in which the fact was alleged in justification of the ways of Providence, and for the purpose of shifting the responsibility for the existence of some people on to the right shoulders. But I have always taken this phrase about "self-making" to be a metaphor, and a very foolish one, inasmuch as the men said to be self-made are usually those whom nature has especially favoured with costly gifts and exceptional opportunities. No doubt it may be said, with justice, that a man who learns diligently and strives hard to do right, really bestows labour on himself, and does so far fulfil the necessary conditions of self-ownership laid down in "Progress and Poverty." But, on the other hand, might not his teachers, on the very same ground, claim possession of the fruits of their labours in him? Might not the mother, who not only bore him, but bore with him, day and night, for half-a-dozen years, fed him, clothed him, nursed

him in sickness, taught him the rudiments of civilisation–might not she [366] rightfully appeal to this wonderful labour-test of ownership?

Is there any logical way out of the following argumentation, the like of which is perhaps to be found only in "Alice in Wonderland"? The exertion of labour in production is the only title to exclusive possession. No gratuitous offering of Nature can be the subject of such private ownership. Therefore a man can have no exclusive possession of himself, except in so far as he is the product of the exertion of his own labour and not a gratuitous offering of Nature. But it is only a very small part of him which can in any sense be said to be the product of his own labour. The man's physical and mental tendencies and capacities, dependent to a very large extent on heredity, are certainly the "gratuitous offering of Nature;" if they belong to anybody, therefore, they must belong to the whole of mankind, who must be, so to speak, a kind of collective slaveowners, all of each. So much of the man as depends on the care taken of him in infancy and childhood is the property of his mother, or of those who took her place. Another smaller portion belongs to the people who educated him. What remains is his own. So that the man's right to himself and to all his powers and to all the fruits of his labour, which the writer of "Progress and Poverty" makes the foundation of his system, turns out, if we follow another fundamental proposition of the [367] same author to its logical consequences, to be a right to a mere fraction of himself and to the exercise of the powers which exclusively belong to that fraction. Surely it would take a greater sage than Solomon to settle the respective claims of mankind in general, the mother and the educators, to the ownership of a child; and when these were satisfied, what might remain in the shape of a right to himself would be hardly big enough to form a safe basis for anything, let alone property.

Unless my readers can see their way better than I can through this logic-chopping maze, we must give up the attempt to reconcile the two fundamental propositions of the system we are discussing: the first, that labour is the "only" title to exclusive possession, and the second, that the foundation of this title lies in the right of a man to himself–that is to say to the exclusive possession of himself. What our political philosopher appears to me to mean is this. A man is the exclusive possessor of himself and of the powers with which he is endowed by Nature; therefore he is the exclusive possessor of whatever is brought into existence by the exertion of those powers in the form of labour. On the other hand, a man possesses, exclusively, nothing else than these powers, therefore he cannot be the exclusive possessor of anything but that which they produce. Substantially, as I have said, it is the position taken up by the Physiocrats, and, [368] right or wrong, it is, at any rate, intelligible. But I do not quite see how it is to be proved by any one who disputes it. The statement that a man is the exclusive possessor of himself, even in the sense of bare ownership, is most assuredly not known to be true by intuition–as, for example, the proposition that two straight lines will not enclose a space is said to be. The whole ancient Roman world would have cried out against it. For them, a man's children, grown up or not, no less than his slaves, were so far from being exclusive possessors of themselves that their father could dispose of them as he thought fit. Nor, as far as I know, is there any part of the modern world in which a legal "infant" has the full ownership of himself and the absolute right to the usufruct of his own powers. Again, to the best of my knowledge, there is no country or nation in which an adult man has, or ever had, in any sense, the exclusive possession of himself. On the contrary, the state invariably lays claim to him for the discharge of various military or civil offices, and to more or less of the fruits of his exertions in the shape of rates and taxes for the support of the machinery of external defence and internal protection. In truth, as I have

already pointed out, the very existence of society depends on the fact that every member of it tacitly admits that he is not the exclusive possessor of himself, and that he admits the claim [369] of the polity of which he forms a part, to act, to some extent, as his master. I do not think we need discuss, any further, propositions which, as they are stated, are contradictory; and which, when they are remodelled so as to escape such contradiction, fall into the no less fatal difficulty of contradicting plain facts. The axiom that a man has a right to himself, in the sense in which it is used in "Progress and Poverty," is a baseless assumption of exactly the same order as that other that all men are free and equal.

However, there is no greater mistake than the hasty conclusion that opinions are worthless because they are badly argued. The principle that "the exertion of labour in production is the only title to exclusive possession" has a great deal to say for itself if we only substitute "may be usefully considered to be a" for "is the only." And, besides this, it will be interesting to trace out its logical consequences, even without such alteration. For we shall find our result to be wonderfully different from that set forth in "Progress and Poverty." It is there declared to be irreconcilable with exclusive (or several) ownership of land. I think that it will become apparent that it authorises the several ownership of land to exactly the same extent as it does the several ownership of anything else.[5]

[370] Let us consider what "Progress and Poverty" has to say about this question.

"What most prevents the realisation of the injustice of private property in land is the habit of including all the things that are made the subject of ownership in one category, as property . . . The real and natural distinction is between things which are the produce of labour and things which are the gratuitous offerings of Nature; or, to adopt the terms of political economy, between wealth and land. These two things are in essence and relations widely different, and to class them together as property is to confuse all thought when we come to consider the justice, or the injustice, the right or wrong of property....

The essential character of the one class of things is that they embody labour, are brought into being by human exertion, their existence or non-existence, their increase or diminution, depending on man. The essential character of the other class of things is that they do not embody labour, and exist irrespective of human exertion and irrespective of man, they are the field or environment in which man finds himself; the storehouse from which his needs must be supplied; the raw material upon which and the forces with which his labour alone can act."–("Progress and Poverty," pp. 238–239.)

The latter kind of property is land, the former all other commodities which constitute men's possessions; and the latter are said, it will be observed, to be "brought into being by human exertion, their existence or non-existence, their increase or diminution depending on man." Surely this is an assertion which, though pardonable enough as a common manner of speaking, [371] becomes a glaring fallacy the moment it is regarded as a scientific statement from which the most serious practical consequences are deducible. Can anything whatever, in strict truth, be said to be "brought into being by human exertion"? Let us consider one of the earliest and simplest products of human industry, a flint implement. Probably, its earliest condition was a natural flint nodule, such as one may find on any chalk down, rounded at one end, roughly sharp at the other, and thus convenient to the hand of the savage who picked it up. Now did he thus acquire any right of property in his find or not? He certainly spent no labour upon it, beyond that

of taking possession. It was emphatically "a gratuitous offering of Nature," just as much as the land on which it lay. The existence or the non-existence of flints, their increase or diminution, nowise depends on man; they exist irrespectively of him, their quantity is strictly limited, and no man, by taking thought, can add a flint to those which already exist. If taking possession could give a title to the one thing, why not to the other? But suppose it did not. Let it occur to our forefather that a few knocks with another stone would chip the thin end of his flint to a sharper edge and make it a handier tool or weapon. Let him give those half-dozen blows; then, forsooth, it "embodies labour" and may be said to have been "brought into being by human exer[372]tion." By the sacramental operation of these half-dozen taps, that which previously was the common property of all men has now become several property vested "by natural law" absolutely in one man.

With the gradual improvement of the art of flint chipping, the implement advanced from the rough, hardly modified, natural nodule to the exquisitely symmetrical and delicate axe, or spear, or arrow head, of a subsequent epoch, or to the still more finished ground axes of yet later date. The quantity of labour invested in each implement, therefore, steadily increased, as time went on, in proportion to the quantity of the raw flint. But the latter was always there. The assertion that the most perfected and artificial of these implements is "brought into being by human exertion," becomes a gross error if it leads us to forget that, without the peculiar physical properties of the flint, which are emphatically "the gratuitous offering of nature," any amount of human exertion would be thrown away.

What is true in this extremely simple case, is true of everything which is said to be produced by human industry. In all such things there is something–a bundle of natural qualities and powers which exists irrespective of human exertion–and something, a shaping and modification of the bundle, which is the effect of human exertion. It is only the relative proportion of the [373] two which varies.[6] A man who hurls a stone loads it with a dose of labour which evaporates when the missile strikes its object, and the stone returns to its previous condition of a mere offering of Nature. A man who slices the same stone and cuts a cameo out of the slice, permanently incorporates an enormous amount of labour with it.

In the one case, the "gratuitous offering" is at a maximum, in the other at a minimum; but the foundation in each case is a gift of Nature.

"Progress and Poverty" sets before us the case of a steel pen with much elaboration (p. 236). But the author fails to notice the patent fact that the iron ore, the existence of which is the *conditio sine qud non* of that of the pen, is a gratuitous offering of Nature. The well-known case of the chronometer balance-wheel spring would have still better exemplified the maximum incorporation of labour with the minimum of "the gratuitous offering."

Now is there any real difference between land and other things in this respect? In Upper Egypt, I have stood with one foot on soil bearing a rich green crop, and the other on the stony desert, as barren as a brick floor, which extended for hundreds of miles to the westward without supporting so much as a blade of grass. The green crop, in fact, reached exactly as far as the [374] muddy water of the Nile had been carried by the labour of its irrigator. Surely, in this case, the cultivable land "embodies labour" and

had no more existence independently of human exertion than the pen or the watch spring.

In the state of nature, I doubt if ten square miles of the surface of the chalk downs of Sussex would yield pickings enough to keep one savage for a year. But, thanks to the human labour bestowed upon it, the same area actually yields, one way or another, to the agriculturist the means of supporting many men. If labour is the foundation of the claim to several ownership, on what pretext can the land, in this case also, be put upon a different footing from the steel pen? The same argument holds good for even the richest soil in the west of North America or in the south of Russia. In the natural state of such land, the savage hunter needs access to a vast area in order to make even a precarious livelihood. The labour spent upon it is an important factor in bringing about its rich harvests.

If we keep these simple and obvious truths in mind, the value of the following argument will be readily appraised:–

"The right to exclusive ownership of anything of human production is clear. No matter how many the hands through which it has passed, there was at the beginning of the line, human labour–some one who, having procured or produced it by his exertions, had to it a clear title as against all the rest of [375] mankind, and which could justly pass from one to another by sale or gift."[7]

Suppose, however, that we let this go and proceed to the next sentence:–

"But at the end of what string of conveyances or grants can be shown or supposed a like title to any part of the material universe?"

Well, but surely all "human productions," from the roughest flint implement to the most exquisite chronometer, are "parts of the material universe"? We have seen that man cannot make flints; nor can he make the iron, or gold, or sodium, or silicon, which enters into the structure of the watch or the pen. His most consummate art is but a moving into certain places of the material universe with which Nature supplies him at least as gratuitously as she supplies land.

What then becomes of the next part of the argument?

"To improvements such an original title can be shown, but it is a title only to the improvements and not to the land itself. If I clear a forest, drain a swamp, or fill a morass, all I can justly claim is the value given by these exertions. They give me no right to the land itself, no claim other than to my equal share with every other member of the community in the value which is added to it by the growth of the community."

By a parity of reasoning, it would seem that I might say to a chronometer maker: "The gold and the iron of this timepiece, and in fact, all the [376] substances out of which it is constructed, are parts of the material universe, therefore the property of mankind at large. It is very true that your skill and labour have made a wonderful piece of mechanism out of them; but these are only improvements. Now you are quite entitled to claim the improvements, but you have no right to the gold and the iron–these belong to

mankind."

The watchmaker might reasonably think the task set before him as difficult as that imposed upon Shylock, when he was told that he was entitled to have his pound of flesh, but that he must shed no blood in cutting it out. He might urge that for all practical purposes the "improvements" are the chronometer, while the gratuitous offering of Nature in the shape of raw material is relatively insignificant. To the ordinary mind there seems to be a great deal of sanity in this contention: not so to our political philosopher.

"But it will be said: 'There are improvements which in time become indistinguishable from the land itself!' Very well; then the title to the improvements becomes blended with the title to the land: the individual right is lost in the common right. It is the greater that swallows up the less, not the less that swallows up the greater. Nature does not proceed from man, but man from Nature, and it is unto the bosom of Nature that he and all his works must return again." (p. 243.)

What answer is appropriate to such stuff as this but Mr. Burchell's famous, if unpolite, monosyllable, "Fudge"?

[377] It is one of the special characteristics of the *a priori* school to assume the exact truth of any currently received proposition which is convenient for the business of deductive brain-spinning. But every one who is conversant with things, and not merely with what is more or less properly said about things, is aware that most widely received propositions, even in many branches of physical science, may be only approximately true; and that if a chain of deductions of unusual weight is to be suspended from any of them, it is highly needful to examine it afresh, in order to see whether it will bear the strain–whether, in fact, it is accurate enough for the new purpose to which it is to be put. For ordinary purposes, a foot rule is an accurate measure, but it does not follow that it will suffice for ascertaining the exact length of the base line of a trigonometrical survey.

In this very case of the ownership of land, Mr. George essentially agrees with the Physiocrats who declared agriculture to be the only really productive industry, because land alone produces the food-stuffs by which men maintain their existence. In a rough and ready sense this is true, and it would be pedantic to object to it. But when such a statement is taken as the peg on which to hang deductions which end in grave practical consequences, it is needful to re-examine it thoroughly. And an elementary knowledge of the realities of the case enables one to see that, in [378] any but a popular sense, the proposition is untrue. In a strictly scientific sense, the soil is no more a producer than air and water and sunshine are; indeed, is altogether less important than they as a condition of production. For food-plants, which are the producers and the only producers of foodstuffs properly so called, could not possibly get on without air, water, and sunshine, though they might do without soil. It would be possible to grow a crop of food-plants, no part of which had ever been in contact with the soil. On the other hand, the richest of soils may be as barren as the desert in regard to economic production–for the simple reason that it is occupied by a luxuriant growth of plants that are not producers of foodstuffs adapted to human needs.

The "gratuitous offering of Nature" in the shape of a hundred acres of tropical forest would be of not much more use to a savage than the like area of a gorse common.

We have all this time been occupied with the eleven pages–not very large pages either–which make up the first chapter of the seventh book of "Progress and Poverty"; but there are more fallacies than pages, and I have not yet done with them. Indeed, like a careful entertainer, I have saved some of the best for the last. Here is a very fine one:–

"The Almighty, who created the earth for man, and man for [379] the earth, has entailed it upon all the generations of the children of men by a decree written upon the constitution of things–a decree which no human action can bar and no prescription determine." (p. 240.)

One would think that the utterer of these "prave 'ords" had been the conveyancer who effected the entail of which he speaks thus confidently. Big-sounding but empty phrases may be the making of a stump-orator; but what is to be said of them in the mouth of a professed thinker? And what is the practical outcome of this tall talk?

"Though his titles have been acquiesced in by generation after generation, to the landed estates of the Duke of Westminster, the poorest child that is born in London to-day has as much right as his eldest son. Though the sovereign people of the State of New York consent to the landed possessions of the Astors, the puniest infant that comes wailing into the world in the squalidest room of the most miserable tenement house, becomes at that moment seized of an equal right with the millionaires. And it is robbed if the right is denied. (p. 240.)

Landowners can make no just claim to compensation if society choose to resume its right."

("Progress and Poverty," Preface. p. vii.)

Who would not be proud to be able to orate in this fashion? Whose heart would not beat high at the tempest of cheers which would follow stirring words like these addressed to needy and ignorant men? How should the impassioned speaker's ear be able to catch a tone as of the howl of hungry wolves among the cheers? Why [380] should he care that his stirring words might stir up the plain enough conclusion: Well, if these things are all ours as much as theirs, and we are the stronger, why do we not take our own, and that at once? What harm in robbing robbers?

Well, whether exhortations in this style are legitimate or not, this much is certain–that, as I hinted before, it is desirable to make very sure of your ground before proceeding to such extremities. Many years ago I heard of an Englishman who had gone to see the Coliseum at Rome by moonlight. He had been warned that the place was haunted by thieves, and was on the alert. Sure enough, a man brushed hastily past him, and the Englishman, looking back, saw a watch in his hand, Without more ado, our countryman, being a prompt sort of person, knocks the fellow down, captures the watch, and makes off to his hotel, lest there should be accomplices about. And, lo! when he is safe in his room he finds he has two watches.

I am disposed to think that the communities who follow out Mr. George's suggestions will find themselves, on Mr. George's own principles, in the position of our too ready-fisted Briton. For, according to Mr. George, that deed of entail which he should have somewhere in a tin box in his office, confers the land upon "all the generations of the children of men." Hence it follows that the London infant has no more title to the Duke [381] of Westminster's land, and the New York baby no more to Messrs. Astor's land, than the child of a North American squaw, of a native Australian, or of a Hottentot. Property of the community, forsooth! What right has any community, from a village to a nation, to several property in land more than an individual man has?

"Natural justice can recognise no right in one [*body of men*] to the possession and enjoyment of land that is not equally the right of all [*their*] fellows." (p. 240.)

Does it make any difference to the validity of this proposition if I substitute the words in italics for the actual words "man" and "his"? So the splendid prospect held out to the poor and needy is a mere rhetorical mirage; and they have been cheated out of their cheers by mere "bunkum." Consider the effect of a sober and truthful statement of what the orating person really meant or, according to his own principles, ought to mean; say of such a speech as this:–

"My free and equal fellow countrymen, there is not the slightest doubt that not only the Duke of Westminster and the Messrs. Astor, but everybody who holds land from the area of a thousand square miles to that of a tablecloth, and who, against all equity, denies that every pauper child has an equal right to it, is a Robber. (Loud and long-continued cheers; the audience, especially the paupers, standing up and waving hats.) But, my friends, I am also bound to tell you that neither the pauper child, nor Messrs. Astor, nor the Duke of Westminster, have any more right to the land than the first nigger you may meet, or the Esquimaux at the north end of this great continent, or [382] the Fuegians at the south end of it. Therefore, before you proceed to use your strength in claiming your rights and take the land away from these usurping Dukes and robbing Astors, you must recollect that you will have to go shares in the produce of the operation with the four hundred and odd millions of Chinamen, the hundred and fifty millions who inhabit Hindostan, the—(loud and long-continued hisses; the audience, especially the paupers, standing up and projecting handy movables at the orator)."

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[1] Daire, *Physiocrates*, Partie première, pp. 19, 20.

[2] In a note Quesnay says: "This is the definition of Justinian." It would be more accurate, I imagine, to say that it is derived from Ulpian: "Jus naturale est quod natura omnia animalia docuit: nam jus istud non humani generis proprium sed omnium animalium." It is to the same Roman jurist that we owe the maxim that all men, according to the law of Nature, are equal and free: "Quod ad jus naturale attinet, omnes homines sequales sunt." "Quum jure naturali omnes liberi nascerentur." See the exhaustive work of Voigt: *Das jus naturale æqquum et bonum und jus gentium der Römer, Bd.* 1, §5ff, whence these citations are taken.

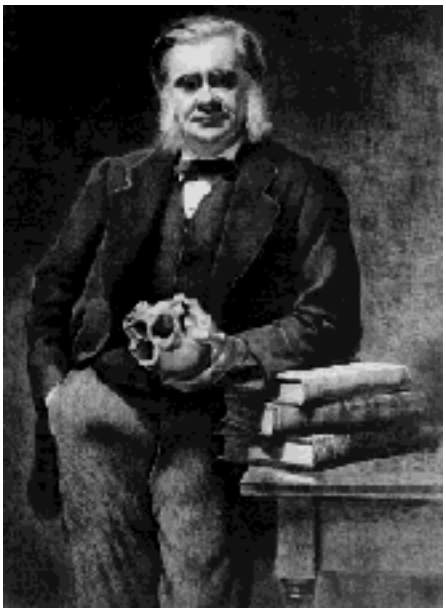
[3] In a note Quesnay observes that this is the case of a man alone in a desert island, whose natural right to the products of the island involves neither justice nor injustice, inasmuch as these terms express the relations of two or more persons.

[4] Sixteen centuries ago, Ulpian drew the conclusion that, according to the "jus naturale," the elements "mare," "aer," and, at any rate, "litora," are the common property of all living things. Isidore of Seville (see *Voigt*, p. 576), probably founding himself on Ulpian, reckons "communis omnium possessio et omnium una libertas, acquisitio corum quæ cœlo, terra marique capiuntur," as among the natural rights of men.

[5] See the clear recognition of this fact in L'Abbe Baudean's *Premiére Introduction à la Philosophie Economique*, 1771, in Daire's collection (p. 657). All *biens* or commodities, including land, are, in the long run, more or less fashioned natural products: "présente de la nature, mais aussi effets de l'art."

[6] I have long since argued all this out in my *Introductory Primer of Science.*

[7] *Progress and Poverty*, p. 242.



Government: Anarchy or Regimentation (May 1890)

Collected Essays I

[383] As a problem of political philosophy, Government presents three principal aspects. We may ask in whom is the sovereign authority vested? Or by what machinery should that authority be exercised? Or in respect of what matters is its exercise legitimate?

The first two of these questions have been discussed by philosophers and fought over by factions from the earliest times. Innumerable battles have been waged about the rival claims of kings, nobles and popular leaders to the "right divine to govern wrong;" and for, or against, the excellence of this or that legislative and administrative apparatus. The third question, on the other hand, has come to the front only in comparatively recent times. But its importance has increased and is increasing rapidly; indeed, at present, it completely over[384]shadows the others. The great problem of modern political philosophy is to determine the province of government. Is there, or is there not, any region of human action over which the individual himself alone has jurisdiction and into which other men have no business to intrude?

In the ancient polities of Greece and Rome hardly any part of human life, except a man's family religious practices, was thus sacred from the intrusion of the State. Beyond the limits of this primary social group even religious liberty ceased. The ancient States permitted no acts which manifested want of respect, still less such as savoured of active opposition, to the cults authorised by the community. Any "infidels" who ventured to give open expression to their lack of faith in the gods of the city were quickly taught that they had better keep their opinions to themselves; and no mercy was shown to those foreign religions the practices of which were judged to be inconsistent with the public welfare. But the old pagan religions had no propaganda; and as persecution is usually a correlate of proselytism, they were fairly tolerant in practice, until the progress of Christianity opened the eyes of the Roman authorities to the fact that civil existence, as they understood it, was incompatible with religious existence, as the Christians understood it. Pagan Rome, therefore, systematically persecuted Christianity with the intention of averting a political catas[385]trophe of the gravest character. The Christian Church was the "International" of the emperors of the second and third centuries.

It is commonly supposed that the result of the intermittent, if internecine warfare thus waged was the victory of the Church, and that, in the words of Julian, the Galilean conquered. But those who compare the Christianity of Paul with that of Constantine's prelates may be permitted to doubt whether, as in so many other cases, the vanquished did not in effect subdue the victor; whether there is not much more of Greek philosophy and of Roman organisation and ritual, than of primitive Christianity, in the triumphant Catholicism of the fourth and later centuries. One heritage of old Roman statecraft, at any rate, passed, bodily over to Catholic churchcraft. As soon as the church was strong enough, it began to persecute with a vigour and consistency which the Empire never attained. In the ages of faith, Christian ecclesiasticism raged against freedom of thought, as such, and compelled the State to punish religious dissidence as a

criminal offence of the worst description. The ingenuity of pagan persecutors failed to reach the shameful level of that of the Christian inventors of the Holy Office; nor did the civil governors of pagan antiquity ever degrade themselves so far as to play the executioner for a camarilla of priests. The doctrine that the authority of the State extends to men's [386] beliefs as well as to their actions, and, consequently, is conterminous with the whole of human life; and that the power of the State ought to be used for the promotion of orthodoxy and the extermination of heterodoxy is, in fact, a necessary corollary of Romanism, which, however disguised by prudence when the Papacy is weak, is sure to reappear when it is strong enough to dispense with hypocrisy. In the sixteenth century, the theory and practice of a thousand years had so thoroughly incorporated intolerance with Christianity, that even the great reformers held firmly by this precious heirloom of the ages of faith, whatever other shards of ecclesiastical corruption they might cast aside. Happily, the pretensions to infallibility of sects, who differed only in the higher or lower positions of the points at which they held on to the slope between Romanism and Rationalism, were so absurd, that political Gallios have been able to establish a *modus vivendi* among them. In this country, at any rate, the State is approaching, if it has not quite reached, a position of non-intervention (inclining perhaps to malevolent neutrality) in theological quarrels.

The prolonged intellectual and physical struggles which have thus tended to the more and more complete exclusion of a great group of human interests and activities from the legitimate sphere of governmental interference, have exerted a powerful influence on the general theory of [387] Government. Two centuries have elapsed since this influence, having for some time made itself felt among political philosophers, prompted that systematic inquiry into the proper limits of governmental action in general, which is contained in John Locke's two Treatises on Government," published in 1689.

The Revolution of 1688 marks one of the acute stages of that contest between Liberalism and Absolutism in these islands which began to manifest itself in a remote period of our history. Liberalism, represented by Parliamentary politicians and Protestant theologians, had prevailed over Absolutism, represented by the Stuarts in the political sphere, and by Papistry, open or disguised, in that of religion. The two "Treatises" form an apology for the victors. A theoretical justification for the accomplished fact was much needed; and Locke would have been unworthy of his reputation as a speculative philosopher, if he had failed to discover, or to invent, a theory sufficiently plausible to satisfy those who desired nothing better than to be persuaded of the justice of acts, by which, in any case, they meant to stand. The first essay is ostensibly directed at poor dead and gone Sir Robert Filmer, with his Adamic mythology (which, by the way, Locke treats as if it were serious history); but the controversial shots are intended to pass through their ostensible object and to slay the defenders of divine right, [388] who lay behind the Filmerian outpost. In the second essay, "On Civil Government," which alone has any interest to us at the present day, the theory of State omnipotence propounded by Hobbes (and supposed, though wrongfully, to have been invented in the interests of monarchy) is vigorously assaulted.

Hobbes was a thinker and writer of marvellous power, and, take him altogether, is probably the greatest of English philosophers; but it was given to him, as little as to Locke, to escape from entanglement in the *a priori* speculations which had come down mainly from the Roman jurists.[1] Setting out from the assumption of the [389] natural equality of men, and of a primary "state of nature" in which every man

strove for the full exercise of his "natural rights," and which was, therefore, a state of war of each against all; Hobbes further assumed that, in order to obtain the blessings of peace, men entered into a contract with one another, by which each surrendered the whole of his natural rights to the person or persons appointed, by common consent, to exercise supreme dominion, or sovereignty, over each and all of the members of the commonwealth constituted by the contract. The authority of the sovereign (whether one man or many, monarch or people[2]) to whom this complete surrender of natural rights was made, was thus absolute and unquestionable. From the time of the surrender, the individual member of the Commonwealth–the citizen–possessed no natural rights at all; but, in exchange for them he acquired such civil rights as the sovereign despot thought fit to grant and to guarantee by the exercise of the whole power of the State, if necessary. Civil law, sanctioned by the force of the community, took the place of "natural right," backed only by the force of the individual. It follows that no limit is, or can be, theoretically set to State interference. The citizen of the "Leviathan" is simply a member of a composite organism controlled by the State will; he has no more freedom in religious matters [390] than in any others; but is to perform the practices of the State religion, and to profess the creed of its theology, whether he likes the one and believes the other, or not. The ideal of the State is a sternly disciplined regiment, in which the citizens are privates, the State functionaries officers, and every action in life is regulated and settled by the sovereign's "Regulations and Instructions." Disobedience is worse than mutiny. For those who disobey need not even be tried by court-martial. By the very act of insubordination they revoke the social contract, and, falling back into the state of nature–that is to say, of the war of each against all–they become aliens, who may be dealt with, summarily, as enemies.

Thus, there are three fundamental points in Hobbes's theory of a polity: First, the primitive state of nature, conceived as a state of war, or unrestricted struggle for existence, among men. Second, the contract, by the execution of which men entered into commonwealths or polities. Third, the complete surrender of all natural rights to the sovereign, and the conferring of absolute and despotic authority upon him, or them, by that contract.

Now, Locke also assumes a primitive state of nature, though its characters are different; he also assumes the contractual origin of the polity; and thus, on these two points, is in general agreement with Hobbes. But, with respect to the third [391] article, he diametrically opposes Hobbes, and declares that the surrender of natural rights which took place when the social compact was made was not complete, but, on the contrary, most strictly and carefully limited.

The difference is of great importance. It marks the point of separation of two schools of *a priori* political philosophy, which have continued to be represented, with constantly increasing divergence, down to the present time, when the ultimate stages of their respective series confront one another as *Anarchy* on the one hand, and *Regimentation* on the other.

But it is necessary to define these epithets with care, before going further. Anarchy, as a term of political philosophy, must be taken only in its proper sense, which has nothing to do with disorder or with crime; but denotes a state of society, in which the rule of each individual by himself is the only government the legitimacy of which is recognised. In this sense, strict anarchy may be the highest conceivable grade of

perfection of social existence; for, if all men spontaneously did justice and loved mercy, it is plain that all swords might be advantageously turned into ploughshares, and that the occupation of judges and police would be gone.[3] Anarchy, as [392] thus defined, is the logical outcome of that form of political theory, which for the last half-century and more has been known under the name of *Individualism.*[4]

I have, unfortunately, no such long established prescription to offer for the term *Regimentation;* but I hope it will be accepted until some one discovers a better denomination for the opposite view, the essence of which is the doctrine of State omnipotence. "Socialism," which at first suggests itself, is unfortunately susceptible of being used in widely different senses. As a general rule, no doubt, socialistic political philosophy is eminently regimental. But there is no necessary connection between socialism and regimentation. Persons, who, of their own free will, should think fit to imitate the primitive Christians depicted by the Acts, and to have all things in common, would be Socialists; and yet they might be none the less Individualists, so long as they refused to compel any one to join them. The only true contradictory of Individualism is that more common kind of [393] Socialism which proposes to use the power of the State in order, as the phrase goes, to "organise" society, or some part of it. That is to say, this "regimental" Socialism proposes to interfere with the freedom of the individual to whatever extent the sovereign may dictate, for the purpose of more or less completely neutralising the effects of the innate inequalities of men. It is militarism in a new shape, requiring the implicit obedience of the individual to a governmental commander-in-chief, whose business is to wage war against natural inequality, and to set artificial equality in its place.

I propose now to give an outline of the progress, first of Regimentation and then of Individualism since the seventeenth century.

In France Regimentation was strongly advocated by Morelly and by Mably before Rousseau's essay on the Social Contract made its appearance; and, to my mind, except in point of literary form, the works of the former two writers are much better worth reading. But, while the immense popularity of Rousseau made him the apparent leader of the movement in favour of social regimentation, the comparative vagueness of his demands for equality commended him to practical politicians. His works became the gospel of the political–one might almost say the religious–sect of which Robespierre and St. Just [394] were the chiefs;[5] and the famous conspiracy of their would-be continuator, Babœuf, was an attempt to bring about the millennium of eighteenth century socialism by sanguinary violence.

According to Rousseau, the social contract is "the foundation of all rights" (chap. ix.); though the sovereign is not bound by it (chap. vii.), inasmuch as he can enter into no contract with himself. This sovereign is the totality of the citizens. Each, in assenting to the social contract, gives himself and all he possesses to the sovereign (vi.), "lui et toutes ses forces dont les biens qu'il possède font partie" (chap. ix.). He loses his natural liberty, and the State becomes master of him and of his goods (chap. ix.). As nature gives a man absolute power over all his members, the social compact gives the polity an absolute power over its citizens. The State, however, does not really despoil him. He gets back civil liberty (that is, such amount of liberty as the State [395] decrees) and a right of property in that which he possesses (chap. viii.). His previous possession, which was bare usurpation, is thus changed into right. In this way

members of the community become mere depositaries of the public property, the private right of ownership being subordinate to the supreme right of the community (chap. ix.). The general will is the source of authority; whoever refuses to obey its behests is to be coerced into obedience by the whole body–"which means nothing more than that he shall be forced to be free" (chap. vii.). As will be seen on turning to the extracts from the "Philosophical Rudiments" given above (p. 388, *note*), most of this is Hobbism pure and simple. The fundamental principle of the Rousseauite, as of the Hobbist, polity is the omnipotence of the State; its boasted liberty is a grant from the sovereign despot, whose absolutism is sugared over by the suggestion that each man has an infinitesimal share in it. And, if any one of the sovereign people should be as blind to the benefits of this sort of free bondsmanship and coerced brotherly love as the "Needy knifegrinder" was, his "incivism" is to be cured by physical treatment: "On le forcera d'être libre."

The despotism of the "general will" (*volonte generale*) being thus established, how is the sovereign to make his commands known? This is a point about which it is surely necessary to be very [396] clear. Unfortunately, Rousseau leaves it not a little obscure. He commences the second chapter of his second book by declaring that the general will is that of the body of the people; that, as such, the declaration of it is an act of sovereignty, while the declaration of the will of a part of the people is merely an act of administration. Yet, in a note, we are told that for the "will" to be "general" it need not be unanimous, only all the votes must be taken. How the expression of will which is not unanimous can be other than that of a part of the people, does not appear. But full light is thrown upon Rousseau's real meaning in the second chapter of the fourth book. Following Locke's dictum that nothing can make a man a member of a commonwealth "but his actually entering into it by positive engagement and express promise and compact" ("Civil Government," §122) he tells us that

"the only law which, by its nature, requires unanimous assent, is the social compact: for civil association is the most voluntary of all acts: every man being born free and master of himself, no one, under any pretext whatever, can subject himself without avowal of the act."

Those who do not assent when the social contract is made remain strangers among the citizens; but after the State is constituted, residence within its bounds is to be taken as assent to the contract.

[397] "Outside this primitive contract, the vote of the majority obliges the test; that is a consequence of the contract itself."

In the Rousseauite State, then, sovereignty means neither more nor less than the omnipotence of a bare majority of voices of all the members of the State collected together in general meetings (chaps. xii.–xiv.).

During the sittings of this sovereign multitude, which are to take place at fixed intervals,

"the jurisdiction of the government ceases, the executive power is suspended, and the person of the lowliest citizen is as sacred and inviolable as that of the highest magistrate; for where the represented is present the representative ceases to exist."

In fact, in each of these periodical meetings, the polity potentially returns to the state of nature, and its members, if they please, may dissolve the social contract altogether: if they do not so please, they reappoint office-bearers to do the work assigned to them, whatever that may be (iii. chap. xvii.), until the next assembly. Society is thus a sort of joint-stock company, whose officers vacate their posts at every general meeting, and whose shareholders can wind up the concern, or go on, as the assembly may resolve, with such articles of association as a bare majority of the shareholders may determine shall be binding until the next meeting. An industrial company organised in this way would probably soon resign sove[398]reignty to a liquidator. But then the members of industrial associations certainly do not undergo that transfiguration which, according to Rousseau, is worked by entrance into the social contract. "The general will," says he, "is always upright and always tends towards the general good" (1iv. ii. chap. iii.); "the people are never corrupted" (*ibid.*); "all constantly desire the happiness of each" (1iv. ii. chap. iv.).

Unfortunately, the intellect and the information of the sovereign are not always quite up to the standard of his morality:–

"The general will is always just; but the judgment which guides it is not always enlightened (1iv ii chap vi.)."

It would seem that flattery of the sovereign is not peculiar to monarchies. Notoriously, kings can do no wrong, and always spend their lives in sighing for the welfare of their subjects. If they seem to err, it is only because they are misled and misinformed. That has been the great make-believe of apologists for despotism from all time.

A properly enlightened sovereign people, with its incorruptible altruism, can never lose sight of the true end of legislation, the greatest good of all; and if we seek to know what that is, Rousseau tells us that it embraces two things, Liberty and Equality (1iv. ii. chap. xi.). Liberty, he says, is "obedience to the law which one has laid down for oneself" (1iv. i. chap. viii.); a well-sounding [399] definition. But to my mind it is somewhat hard to reconcile with the obligation to submit to laws laid down by other people who happen to be in a majority. Unless, indeed, this "law which one has laid down for oneself" simply inculcates obedience to the majority. But, if that be liberty, then liberty is no less possessed by the man who makes it a law to himself to obey any master; and liberty is as fully possessed by the slave who makes up his mind to be a slave, as by the freest of free men.

With respect to the other aim of government, the maintenance of equality, Rousseau makes an instructive statement in answering the objection that the attempt is chimerical.

"It is precisely because the nature of things (*force des choses*) continually tends to the destruction of equality, that the power of legislation ought always to tend to maintain it."[6]

[400] Absolute equality of power and wealth is not required, but neither opulence nor beggary is to be permitted; and it is to depend upon the legislators' view of the circumstances whether the community

shall devote itself to agriculture or to manufactures and commerce (1iv. ii. chap. xi.). Thus the State is to control distribution no less than production. Moreover, the sovereign people is to settle the articles of a. State religion, not exactly as religious dogmas, but as "sentiments of sociability without which a man can neither be a good citizen nor a faithful subject":–

"Without being able to oblige any one to believe them, he may banish from the State whoever does not believe them; he may banish them, not for impiety, but for unsociability–as persons incapable of sincerely loving the laws or justice, and of sacrificing themselves to duty if needful.... If any one, after having acknowledged these same dogmas, conducts himself as if he did not believe them, let him be punished with death: he has committed the greatest of crimes, he has lied before the law (1iv. iv. chap. viii.)."

The articles of the State creed are: the existence of a powerful, intelligent, beneficent, foreseeing and provident Deity; the life to come, the happiness of the just, the punishment of the [401] wicked, the sanctity of the social contract and of the laws. These are the positive doctrines of the Rousseauite creed. Of negative dogmas there is only one, and the reader may be surprised to learn that it enjoins the repression of intolerance. Having banished unbelievers in the State creed and put to death lapsed believers, Rousseau thanks God that he is not as those publicans, the devotees of "les cultes que nous avons exclus"–intolerant. Does he not proclaim that all religions which tolerate others should themselves be tolerated? Yet the qualificatory provision, "so far as their dogmas are in no way contrary to the duties of the citizen," would seem to effect a considerable reduction in the State toleration of the tolerators; since, as we have just seen, it is obligatory on the citizen to profess the State creed.

Whether Rousseau used the works of Morelly and of Mably, as he did those of Hobbes and Locke, and whether his reputation for political originality is not of that cheap and easy sort which is won by sedulously ignoring those who have been unmannerly enough to anticipate us, need not be discussed. At any rate, important works of both these authors, in which the principles to be found in the essay on the "Social Contract" are made the foundation of complete schemes of regimental socialism with community of goods, were published earlier than that essay. Robespierre and St. Just went as far as Rousseau in the direction of enforc[402]ing equality, but they left it to Babœuf to try to go as far as Mably. In their methods of endeavouring (by the help of the guillotine) to "force men to be free," they supplied the works naturally brought forth by the Rousseauite faith. And still more were they obedient to the master in insisting on a State religion, and in certifying the existence of God by a governmental decree.

The regimental Socialists of our own time appear to believe that, in their hands, political regimentation has taken a new departure, and substantially differs from that of the older apostles of their creed. Certainly they diverge from the views of Owen or of Fourier; but I can find nothing of importance in the serious writings of the modern school, nor even in their romances, which may not be discovered in the works of Morelly and of Mably, whose advocacy of the doctrines that several ownership is the root of all the evils of society; that the golden age would return if only the State directed production and regulated consumption; and that the love of approbation affords a stimulus to industry, sufficient to replace all those furnished by the love of power, of wealth and of sensual gratification, in our present imperfect state, is as powerful as that of any later writers.

We may now turn to the other line of development of political philosophy based upon *a priori* [403] arguments, which is represented by individualism in various shades of intensity. I have already said that the founder and father of political individualism, as it is held by its more moderate adherents at the present day, is John Locke; and that his primary assumptions–the state of nature and the contractual basis of society–are the same as those of his predecessor Hobbes, and of his successors Rousseau and Mably. But I have also remarked that the condition of men in the state of nature, imagined by Locke, is different from that assumed by either Hobbes or Rousseau. For these last philosophers, primitive man was a savage; lawless and ferocious according to the older, good and stupid, according to the younger, theorist. Locke's fancy picture of primitive men, on the other hand, represents them under the guise of highly intelligent and respectable persons, "living together according to reason, without a common superior on earth, with authority to judge between them" ("Civil Government," § 19).

The Law of Nature[7] is, in fact, the law dictated by reason, which "teaches all mankind who will but consult it, that, being all equal and independent, no one ought to harm another in his life, [404] liberty, or possessions." Elsewhere (§ 4), the state of nature is defined as a state of "perfect freedom," in which men "dispose of their possessions and persons as they think fit"; and further as a state of equality,

"wherein all the power and jurisdiction is reciprocal, no one having more than another; there being nothing more evident than that creatures of the same species and rank, promiscuously born to all the same advantages of nature,[8] and the use of the same faculties, should also be equal one amongst another without subordination or subjection."

Again (§ 7), since the law of nature "willeth the peace and preservation of all mankind," every man has a "right to punish the transgressors of [405] that law "; that is to say, those who invade the rights of others. Moreover, truth and the keeping of faith are commands of the Law of Nature, and belong "to men as men," and not as members of society (§ 14). Locke uses the term Law of Nature, therefore, in the sense in which it was often (perhaps generally) employed by the jurists, to denote a system of equity based on purely rational considerations.

There is no connection between this law of nature and "natural rights," properly so called. The state of nature imagined by Locke is, in fact, the individualistic golden age of philosophical anarchy, in which all men voluntarily rendering *suum cuique*, there is no need of any agency for the enforcement of justice. While Hobbes supposes that, in the state of nature, the Law of Nature was silent, Locke seems to imagine that it spoke loudly enough, but that men grew deaf to it. It was only in consequence of the failure of some of them to maintain the original standard of ethical elevation that those inconveniences arose which drove the rest to combine into commonwealths; to choose rulers; and to endow them, as delegates of all, with the sum of the right to punish transgressors inherent in each.

In taking this important step, however, our forefathers exhibited that caution and prudence which might be expected from persons who dwelt upon the ethical heights which they had reached [406] in the state of nature. Instead of making a complete surrender of all the rights and powers which they possessed in

that state, to the Sovereign, and thus creating State omnipotence by the social contract, as Hobbes wrongfully declared them to have done, they gave up only just so much of them as was absolutely necessary for the purposes of an executive with strictly limited powers. With the Stuarts recognised by France, and hosts of Jacobite pamphleteers on the look-out for every coign of vantage, it would never do to admit the Hobbesian doctrine of complete surrender. So Locke is careful to assert that when men entered into commonwealths they must have stipulated (and, therefore, on approved *a priori* principles, did stipulate) that the power of the Sovereign was strictly limited to the performance of acts needful "to secure every one's property."

"§131. But though men, when they enter into society, give up the equality, liberty, and executive power they had in the state of nature, into the hands of the society to be so far disposed of by the legislative, as the good of society shall require; yet it being only with an intention in every one the better to preserve himself, his liberty and property; (for no rational creature can be supposed to change his condition with an intention to be worse), the power of the society, or legislative constituted by them, can never be supposed to extend farther, than the common good; but is obliged to secure every one's property by providing against those three defects above mentioned, that made the state of nature so unsafe and uneasy."[9]

[407] To listen to Locke, one would imagine that a general meeting of men living in the state of nature having been called to consider the "defects" of their condition, and somebody being voted to the tree (in the presumable absence of chairs), this earliest example of a constituent assembly resolved to form a governmental company, with strictly limited liability, for the purpose of defending liberty and property; and that they elected a director or body of directors, to be known as the Sovereign, for the purpose of carrying on that business and no other whatsoever. Thus we are a long way from the absolute Sovereign of Hobbes. Here is the point, in fact, at which Locke diverged from the older philosopher; and at which Rousseau and Mably, after profiting as much as they could by Locke's "Essay," left him and laid the theoretical foundations of regimental socialism.

The physiocrats of the eighteenth century, struggling against the effects of that "fureur de gouverner," which one of their leaders, the elder Mirabeau, called the worst malady of modern states, and which had nearly succeeded in strang[408]ling every branch of French industry and starving the French people, necessarily welcomed and adopted Locke's individualistic formula. Their favourite maxim of "Laissez faire" was a corollary of the application of that formula in the sphere of economy; and it was a great thing for them to be able to add to the arguments based on practical expediency, which could be properly appreciated only by those who took pains to learn something about the facts of the case, the authority of a deduction from one of those *a priori* truths, the just appreciation of which is supposed to come by nature to all men. The axiom of absolute ethics in question has been stated in many ways. It is laid down that every man has a right to do as he pleases, so long as he does no harm to others; or that he is free to do anything he pleases, so long as he does not interfere with the same freedom in others. Daire, in the introduction to his "Physiocrates" (p. 16), goes so far as to call the rule thus enunciated a "law of nature."

"La loi naturelle qui permet à chacun de faire tout ce qui lui est avantageux sous la seule condition de ne pas nuire à autrui."[10]

[409] The physiocrats accepted the dogma of human equality, and they further agreed with Locke in considering that the restriction of the functions of the Government to the protection of liberty and property was in nowise inconsistent with furtherance of education by the State. On the contrary they considered education to be an essential condition of the only equality which is consistent with liberty. Moreover, they laid great stress on the proposition that justice is inseparably connected with property and liberty. Nothing can be stronger than the words of Quesnay on this point:–

"Là où les lois et la puissante tutelaire n'assurent point la propriété et la liberté, il n'y a ni gouvernement ni société profitables; il n'y a que domination et anarchie sous les apparences d'un gouvernement; les lois positives et la domination y protégent et assurent les usurpations des forts, et anéantissent la propriété et la liberté des faibles."[11]

That is to say, the absolute political ethics of the individualist leave as little doubt in his mind that private property and the right to deal freely with it are essential to the protection of the weak against the strong, as the absolute political ethics [410] of the regimental socialist assure him that private property and freedom of contract involve the tyranny of the strong over the weak.

Through the widespread influence of the "Wealth of Nations," individualism became a potent factor in practical politics. Wherever the principles of free-trade prevailed and were followed by industrial prosperity, individualism acquired a solid fulcrum from which to move the political world. Liberalism tended to the adoption of Locke's definition of the limits of State action, and to consider persistence in letting alone as a definition of the whole duty of the statesman. But in the hands of even the most liberal governments, these limits proved pretty elastic; and, however objectionable State interference might be, it was found hard to set bounds to it, if indirect as well as direct interference were permissible. So long ago as the end of the eighteenth century, the distinguished scholar and statesman Wilhelm von Humboldt[12] attempted to meet this difficulty. He wrote a special treatise, which remained unpublished till sixty years later, for the purpose of showing that the legitimate functions of the State [411] are negative; and that governments have no right to take any positive steps for the promotion of the welfare of the governed. Von Humboldt does not encumber himself with Locke's "limited contract," but starts an *a priori* axiom of his own, namely:–

"That reason cannot desire for any man any other condition than that in which each individual not only enjoys the most absolute freedom of developing himself by his own energies in his perfect individuality, but in which external nature even is left unfashioned by any human agency, but only receives the impress given to it by each individual by himself and his own free will, according to the measure of his wants and instincts, and restricted only by the limits of his powers and rights." (p. 18).

From this very considerable assumption (which I must say does not appear to me to possess the quality of intuitive certainty) the conclusion is deduced that

"the State is to abstain from all solicitude for the positive welfare of the citizens and not to proceed a step farther than is necessary for their mutual security and protection against foreign enemies; for with no other object should it impose restrictions on freedom."

This conclusion differs but little from that of Locke, verbally. Nevertheless in its practical application, Von Humboldt excludes not only all and every matter of religion, of morals, and of education, but the relations of the sexes, and all private actions not injurious to other citizens, from [412] the interference of the State. However, he permits governmental regulation of the power of testamentary devolution; and (though somewhat unwillingly) interference with acts which are not immediately hurtful to one's neighbours, yet the obvious tendencies of which are to damage them or to restrict their liberties.

By far the best and fullest exposition known to me of the individualism which, in principle, goes no further than Locke's formula, is Dunoyer's "Liberte du Travail" of which the first volume was published in 1825, and the whole work in 1845. One great merit of the author is the resolute casting aside all the *a priori* figments of his predecessors; and another lies in his careful and elaborate discussion of the historical growth of Individualism, which goes a long way towards the establishment of the conclusion, that advance in civilisation and restriction of the sphere of Government interference have gone hand in hand. J. S. Mill has referred to Dunoyer's work; but later expositors of Individualism ignore him completely, although they have produced nothing comparable to the weighty case for the restriction of the sphere of government, presented with a force which is not weakened by fanaticism, in the seventh chapter of the ninth book of Dunoyer's work.

The year 1845 is further marked in the annals of Individualism by the appearance of Stirner's [413] "The Individual and his Property,[13] "in which the author, going back to first principles, after a ruthless criticism of both limited Individualism and regimental Socialism, declares himself for unlimited Individualism; that is to say, Anarchy. Stirner justly points out that "natural right" is nothing but natural might. Man, in the state of nature, could know of no reason why he should not freely use his powers to satisfy his desires. When men entered into society they were impelled by self-interest. Each thought he could procure some good for himself by that proceeding; and his natural right to make the most out of the situation remained intact. The theory of an express contract, with either complete or incomplete surrender of natural rights, is an empty figment, nor was there any understanding, except perhaps that each would grasp as much as he could reasonably expect to keep. According to this development of Individualism, therefore, the state of nature is not really put an end to by the formation of a polity; the struggle for existence is as severe as ever though its conditions are somewhat different. It is a state of war; but instead of the methods of the savage, who sticks at no treachery, and revels in wanton destruction, we have those of modern warfare, with its Red Cross ambulances, flags of truce strictly respected, and extermination con[414]ducted with all the delicate courtesies of chivalry. The rules of this refined militancy are called laws, and prudence dictates respect for them because, as it is to the advantage of the majority that they should be observed, the many have agreed to fall upon any one who breaks them; and the many are stronger than the one. Thus the sole sanction of law being the will of the majority, which is a mere name for a draft upon physical force, certain to be honoured in case of necessity; and "absolute political ethics" teaching us that force can confer no rights; it is plain that state-compulsion involves the citizen in slavery, as completely as if any other master were the compeller. Wherever and whenever the individual man is forced to submit to any rules, except those which he himself spontaneously recognises to be worthy of observance, there liberty is absent. And thus we arrive at the position of the great apostle of anarchy, Bakounine, according to whom the liberty of man consists

solely in this: that "he pays obedience to natural laws, because *he himself* admits them to be such, and not because they have been imposed upon him from without by any other will, whether divine or human, collective or individual."[14] Hence it follows that the "sovereign people" worshipped by the great champions of liberty and equality, when it dares to impose the "general will" upon the individual, even if that [415] person be in a minority of one, is as brutal a usurper as ever exercised monarchical tyranny; and, whether a man shall so much as recognise the right of another to the freedom which he himself exercises, is to be left to his private judgment. As all property is robbery, so is all government from without, tyranny.

In this country, where the influence of the pedantry of the Absolute is so much trammelled by common sense and more or less experience of the difference between the nature of things and *a priori* assumptions, Individualism has, usually, stopped short of the conclusions of Stirner and of Bakounine, beyond which, so far as I can see, the *a priori* method can hardly carry its most hardened practitioner. Nevertheless, the "party of Individual Liberty," of which Mr. Auberon Herbert is the spokesman, must, I think, be classified as Anarchist;[15] though the definition of their conception of the relations of the individual to government looks, at first sight, as if it meant no more than limited Individualism.

"Each man and woman are to be free to direct their faculties and their energies according to their own sense of what is right [416] and wise, in every direction except one. They are not to use their faculties for the purpose of forcibly restraining their neighbour from the same free use of his faculties."[16]

And as to Governments–

"They must simply defend the person and property of all persons by whomsoever they are assailed."[17]

This, it will be observed, is the dictum of Locke and nothing more.

But, in the application of the theory to practice, Mr. Herbert goes a good deal further than even Humboldt or Dunoyer. He would do away with all enforced taxation and levying of duties, and trust to voluntary payments for the revenue of the State. The relations of the sexes and the disposition of property by will are to be quite free; traffic of all kinds is to be released from restrictions; state inspection is to be abolished, no less than all hygienic regulations; state education goes, as a matter of course, and with it all state-aided museums, libraries, galleries of art, parks, and pleasure grounds. In fact, the functions of government within the State are rigidly restricted to the administration of civil and criminal justice.

But this is not all. Mr. Herbert oversteps the bounds of limited Individualism and enters the region of Anarchy, when he says he is not quite sure that even this pittance of administrative power is strictly justifiable.

[417] "I do not think that it is possible to find a perfect moral foundation for the authority of any Government, be

it the Government of an emperor or a Republic. They are all of the nature of an usurpation, though I think, when *confined within certain exact limits,* of a justifiable usurpation."[18]

A "justifiable usurpation" is something which I can no more conceive than I can imagine a round square; it being the nature of usurpation, as I imagine, to be unjustifiable. But I presume that what is meant is, that, though government has no moral authority, it is practically expedient that it should be permitted to exist, if confined within very narrow limits. Absolute ethics, in Mr. Herbert's opinion, refuses to acknowledge the right of any government except the government of the individual by himself. Therefore I am unable to discern any logical boundary between Mr. Herbert's position and that of Bakounine.

The fact that Individualism, pushed to its logical extreme, must end in philosophical anarchy, has not escaped that acute thinker and vigorous writer, Mr. Donisthorpe, whose work on "Individualism"[19] is at once piquant, learned, and thoroughgoing–qualities in which the writings of speculative philosophers do not always abound. I commend Mr. Donisthorpe's eighth chapter, entitled "A Word for Anarchy," to those who [418] desire to understand whither the Individualist principle, stripped bare of *a priori* fogs and formulas, and followed out to its consequences, lands its supporters.

Starting from assumptions about the equality of men, their natural rights and the social contract, common to so many political philosophers of the *a priori* school, we have been offered the choice of two alternative routes. Taking that indicated by Hobbes, Rousseau, Mably, and their successors, we have found ourselves committed to the further *a priori* assumption that, when men entered into society, they surrendered all their natural rights; and, acknowledging the omnipotence of the general will, received back such legal and moral obligations and permissions as the Sovereign might be pleased to sanction, Absolute political ethics thus arrived, by a plausible logical process, at *Regimentation;* that is, a quasi-military organisation of society, for the purpose of conquering the general welfare by means of that enforced apparent equality which brings about the hugest of real inequalities.

On the other hand, when we took the path pointed out by Locke and followed by Liberalism, we made an *a priori* assumption of a diametrically opposite character. We said that men entering into the social contract reserved all their natural rights, except such as it was absolutely necessary [419] to yield to government, in order that it should exercise its only legitimate function, the defence of the liberty and property of the individual. According to this limited individualist view, the business of government (except in relation to external enemies) is negative; it is to interfere only for the purpose of preventing any one citizen from using his liberty in such a way as to interfere with the equal liberty of another citizen. According to the regimentalist view, on the contrary, the business of government is not only negative, but also and eminently positive. It is the duty of the State to interfere for the purpose of promoting the welfare of society (of which equality is supposed to be a necessary condition), however much such interference may restrict individual liberty. The final outcome of Regimentation is seen in those extreme forms of regimental Socialism which undertake to regulate not only production and consumption, but every detail of human life; that of Individualism is Anarchy, which abolishes collective government and trusts to the struggle for existence, modified by such ethical and intellectual considerations as may be freely recognised by the individual, for the establishment of a social *modus*

vivendi, in which freedom remains intact, except so far as it may be voluntarily limited,

Granting the premisses, I am unable to see that one of these lines of argument is any better than [420] the other; and they are mutually destructive. But suppose that, not being blinded by any *a priori* cataracts, we use our eyes upon these premisses–what utter shams and delusions they show themselves to be! I hope that no more need be said about natural rights and the equality of men. But there is just as little foundation in fact for the social contract and either the limited, or the unlimited, devolution of rights and powers which is supposed to have been effected by it. We have sadly little definite knowledge of the manner in which polities arose, but, if anything is certain, it is that the notion of a contract, whether expressed or implied, is by no means an adequate expression of the process.

The most archaic polities of which we have any definite record are either families, or federations of families; and the most doctrinaire of political philosophers will hardly be prepared to maintain that the family polity was based upon contract between the *paterfamilias* and his wife and children, and arose out of the expressed desire of the latter to have their liberty and property protected by their governor; or that even any tacit understanding on that subject influenced the formation of the family group. In truth, the more primitive the condition of a polity, the less is there of a contract, either expressed or implied, between its members–the more common is it to find that neither wife nor child possessed either [421] liberty, or property, worth speaking of. The *paterfamilias* of the Aryan stock, at any rate, could say "L'etat c'est moi" with more truth than any later monarch. So far from the preservation of liberty and property and the securing of equal rights being the chief and most conspicuous objects aimed at by the archaic polities of which we know anything, it would be a good deal nearer the truth to say that they were federated absolute monarchies, the chief purpose of which was the maintenance of an established Church for the worship of the family ancestors.

Philosophers, proud of living according to reason, are too apt to forget that people who do not profess themselves to be more than ordinary men mostly live according to unreason; or what seems such to the philosophers. Moderns, who make to themselves metaphysical teraphim out of the Absolute, the Unknowable, the Unconscious, and the other verbal abstractions whose apotheosis is indicated by initial capitals, may find it difficult to imagine that it seemed good to ancient men to perform the same theurgic operation upon their very concrete but deceased forefathers; and to believe that, unless the Manes were regularly propitiated with a supply of such commodities as ghosts can enjoy, they would not only withdraw their benevolent protection, but would make things very unpleasant for their descendants and their fellow countrymen. Yet there can be little question [422] that this theory lies at the foundation of the ancient polity; and that the dominant purpose of its organisation was not the preservation of liberty or property, by taking order that no man used his freedom in a way to interfere with others' freedom, but the performance of those religious obligations by which the good will of the ancestral gods might be secured. Archaic society aims, not at the freest possible exercise of rights, but at the exactest possible discharge of duties. The most marked inequalities and seeming iniquities of ancient law, such as succession in the male line, the acknowledgment of agnate blood relationship only, adoption, divorce for barrenness, are direct consequences of the religious foundation of ancient society. Thus the whole fabric of *a priori* political speculation which we have had under consideration is built upon the quicksand of fictitious history. So far as this method of establishing their claims is concerned, *Regimentation* and

Individualism–enforced Socialism and Anarchy–are alike out of court.

The comments upon the preceding essays which have come under my notice, lead me to suspect that my purpose in writing them has been somewhat misunderstood.

They appear to have been regarded by the regimental socialists as an onslaught specially directed against their position; and as an attempt [423] to justify those who, content with the present, are opposed to all endeavours to bring about any fundamental change in our social arrangements.

Those who have had the patience to follow me to the end will, I trust, have become aware that my aim has been altogether different. Even the best of modern civilisations appears to me to exhibit a condition of mankind which neither embodies any worthy ideal nor even possesses the merit of stability. I do not hesitate to express the opinion, that, if there is no hope of a large improvement of the condition of the greater part of the human family; if it is true that the increase of knowledge, the winning of a greater dominion over Nature which is its consequence, and the wealth which follows upon that dominion, are to make no difference in the extent and the intensity of Want, with its concomitant physical and moral degradation, among the masses of the people, I should hail the advent of some kindly comet, which would sweep the whole affair away, as a desirable consummation. What profits it to the human Prometheus that he has stolen the fire of heaven to be his servant, and that the spirits of the earth and of the air obey him, if the vulture of pauperism is eternally to tear his very vitals and keep him on the brink of destruction?

Assuredly, if I believed that any of the schemes hitherto proposed for bringing about social amelio[424]ration were likely to attain their end, I should think what remains to me of life well spent in furthering it. But my interest in these questions did not begin the day before yesterday; and, whether right or wrong, it is no hasty conclusion of mine that we have small chance of doing wisely in this matter (or indeed in any other), unless we think rightly. Further, that we shall never think rightly in politics until we have cleared our minds of delusions; and, more especially, of the philosophical delusions which, as I have endeavoured to show, have infested political thought for centuries. My main purpose has been to contribute my mite towards this essential preliminary operation. Ground must be cleared and levelled before a building can be properly commenced; the labour of the navvy is as necessary as that of the architect, however much less honoured; and it has been my humble endeavour to grub up those old stumps of the *a priori*, which stand in the way of the very foundations of a sane political philosophy. To those who think that questions of the kind I have been discussing have merely an academic interest, let me suggest, once more, that a century ago Robespierre and St. Just proved that the way of answering them may have extremely practical consequences.

The task which I set before myself, then, was simply a destructive criticism of *a priori* political philosophy, whether regimental or individualistic. [425] But I am aware that the modesty of the purely critical attitude is not appreciated as it ought to be. There is a prevalent idea that the constructive genius is in itself something grander than the critical, even though the former turns out to have merely made a symmetrical rubbish heap in the middle of the road of science, which the latter has to clear away before

anybody can get forward. The critic is told: It is all very well to show that this, that, or the other is wrong; what we want to know is, what is right?

Now, I submit that it is unjust to require a crossing sweeper in Piccadilly to tell you the road to Highgate; he has earned his copper if he has done all he professes to do and cleaned up your immediate path. So I do not think any one has a claim upon me to make any positive suggestions, still less to commit myself to any ambitious schemes of social regeneration such as are now as common as blackberries. Reading and experience have led me to believe that the results of political changes are hardly ever those which their friends hope or their foes fear; and, if I were offered a free hand by Almighty power, I should, like Hamlet, shudderingly object to the responsibility of attempting to set right a world out of joint. But I may perhaps, without presumption, set forth some reflections, germane to the subject, which have now and again crossed my mind.

About this question of government, for example; [426] perhaps it is the prejudice of scientific habit, which leads me to think that it might be as well to proceed from the known to the unknown. Most of us, I hope, have tried their hands at self-government; and those who have met with any measure of success in that difficult art will, I believe, agree with me that safety lies neither in the regimentation of asceticism nor in the anarchy of reckless self-seeking, but in a middle course. Surely there is a time to submit to guidance and a time to take one's own way at all hazards.

A good many of us, again, have had practical experience of the government of that elementary polity, a family. In this business, the people who fail utterly are, on the one hand, the martinet regimentalists and, on the other, the parents whose theory of education appears to be that expounded by the elder Mr. Weller, when, if I remember rightly, he enlarged upon the advantages which Sam had enjoyed by being allowed to roam at will about Covent Garden Market, from babyhood upwards. Individualism, pushed to anarchy, in the family is as ill-founded theoretically and as mischievous practically as it is in the State; while extreme regimentation is a certain means of either destroying self-reliance or of maddening to rebellion.

When we turn from the family to the aggregation of families which constitutes the State, I do not see that the case is substantially altered. The [427] problem of government may be stated to be, What ought to be done and what to be left undone by society, as a whole, in order to bring about as much welfare of its members as is compatible with the natural order of things? and I do not think men will ever solve this problem unless they clear their minds, not merely of the notion that it can be solved *a priori;* but unless they face the fact that the natural order of things–the order, that is to say, as unmodified by human effort–does not tend to bring about what we understand as welfare. On the contrary, the natural order tends to the maintenance, in one shape or another, of the war of each against all, the result of which is not the survival of the morally or even the physically highest, but of that form of humanity, the mortality of which is least under the conditions. The pressure of a constant increase of population upon the means of support must keep up the struggle for existence, whatever form of social organisation may be adopted. In fact, it is hard to say whether the state of anarchy or that of extreme regimentation would be the more rapidly effective in bringing any society which multiplies without limit to a crisis.

The cardinal defect of all socialistic schemes appears to me to be, that they either ignore this difficulty or try to evade it by nonsensical suppositions about increasing the production of vital [428] capital[20] *ad libitum.* Individualism, on the other hand, admitting the inevitability of the struggle, is too apt to try to persuade us that it is all for our good, as an essential condition of progress to higher things. But that is not necessarily true; the creature that survives a free-fight only demonstrates his superior fitness for coping with free-fighters–not any other kind of superiority.

The political problem of problems is how to deal with over-population, and it faces us on all sides. I have heard a great deal about the tyranny of capital. No doubt it is true that labour is dependent on capital. No doubt if, out of a thousand men, one holds and can keep all the capital,[21] the rest are bound to serve him or die. But if, on this ground, labour may be said to be the slave of capital, it would be equally just to say that capital is the slave of labour. A naked millionaire, with a chest full of specie, might be set down in the middle of the best agricultural estate in England; but unless somebody would work for him, he would probably soon perish from cold and hunger, having previously lost everything for lack of protection. The state of things attributed to the tyranny of the capitalist might be far more properly ascribed to the self-enslavement [429] of the wage earners. It is their competition with one another which makes his strength.

Over-population has two sources: one internal by generation, one external by immigration. Theoretically, the elimination of Want is possible by the arrest of both, in such a manner as to restrict the population of any area to the number capable of being fed by the agricultural produce of that area; the manufacturing and professional population being kept down to a number equal to the difference between the necessary agricultural and the total permissible population. A polity of this kind might be self-supporting, and there need be no poverty in it, except such as arose from moral delinquencies or unavoidable calamities.

This is, substantially, the plan of the "Closed Industrial State"[22] set forth by Fichte; and, so far as I can see, there is no other social arrangement by which Want can be permanently eliminated. For if either unrestricted generation or unrestricted immigration is permitted; or if any considerable proportion of the industrial population is allowed to depend for its food upon foreign sources, pauperism becomes imminent–in the first case, by the competition of the native and the imported workers with one another; in the second case, by the competition in the market of foreign industries of the same nature.

I offer no opinion whether Fichte's Utopia [429] is practically realisable or not. That about which I have a very strong opinion is, that political speculators who, while ignoring these conditions, promise a millennium of equality and fraternity, are reckoning sadly without their host, or rather hostess, Dame Nature.

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[1] Hobbes's conception of the State may be sufficiently gathered from the following passages extracted from the

Philosophical Rudiments concerning Government and Society (1651): "All men, therefore, among themselves are by nature equal; the inequality we now discern hath its spring from the civil law" (chap. i. 3). "Nature hath given to every one a light to all" (*ibid.* 10). "The natural state of men before they entered into society was .... a war of all men against all men" (*ibid.* 12). In whatever man or body of men dominion or governmental authority is vested," each citizen has conveyed all his strength and power to that man or council" (chap. v. 11). The supreme power is *absolute* (chap. vi. 13), and comparable to the soul of the city as its will (*ibid.* 19). "The will of every citizen is in all things comprehended in the will of the city, and the city is not tied to the civil laws," and the will of the depository of dominion is the will of the city (chap. vi. 14). Judging of good and evil does not belong to private citizens (chap. xii. 1), nor do they possess any rights or liberties except such as the sovereign grants. All power, temporal and spiritual, is united (under Christ) in the sovereign authority of a Christian city, and absolute obedience is due to it. When the sovereign is not Christian, and his commands are contrary to those of the Church, the subject must, disobeying but not resisting, "go to Christ by martyrdom" (chap. xviii. 13).

[2] See *Philosophical Rudiments,* chapters vi. and vii.

[3] "For if men could rule themselves, every man by his own command, that is to say, could they live according to the laws of nature, there would be no need at all of a city, nor of a common coercive power."–Hobbes, *Philosophical Elements,* chap. vi. 13, *note.*

[4] It is employed as an already familiar appellative by Louis Blanc in the first volume of his *Histoire de la Revolution Francaise,* published in 1847, which contains a very interesting attempt to trace the influence of the principles of authority, of individualism, and of fraternity, through French history. The first volume of the elaborate work of Marlo (Winkelblech), *Organization der Arbeit,* published in 1850, gives a very complete exposition of the theory of Individualism under the name of *Liberalismus.*

[5] As Mr. Lecky justly says: "That which distinguishes the French Revolution from other political movements is, that it was directed by men who had adopted certain speculative *a priori* conceptions of political right, with the fanaticism and proselytising fervour of a religious belief, and the Bible of their creed was the *Contrat Social* of Rousseau" (*History of England in the Eighteenth Century,* vol. v. p. 345). I have not undertaken a criticism of Rousseau's various and not unfrequently inconsistent political opinions, as a whole. It was not needful for my purpose to do so; and, if it had been, I could not have improved upon the comprehensive and impartial judgment of our historian of the eighteenth century.

[6] In spite of all his sentimentalism, Rousseau occasionally sees straight into the realities of things. *.A prendre le terme dans la rigueur de l'acception, il n'a jamais existé de véritable démocratie, et il n'en existera jamais. Il est contre l'ordre naturel que le grand nombre gouverne, et que le petit soit gouverne. .... S'il y avait un peuple de dieux il se gouvernerait démocratiquement. . . . . .Un gouvernement si parfait ne convient pas à des hommes* (1iv. iii. chap. iv.). "A second Daniel come to judgment!" For it would not be far from the truth to say that the only form of government which has ever permanently existed is *oligarchy.* A very strong despot, or a furious multitude, may for a brief space work their single or collective will; but the power of an absolute monarch is, as a rule, as much in the hands of a ring of ministers, mistresses, and priests, as that of Demos is, in reality, wielded by a ring of orators and wire-pullers. As Hobbes has pithily put the case, "A democracy in effect is no more than an aristocracy of orators, interrupted sometimes with the temporary monarchy of one orator" (De Corpora Politico, chap. ii. 5). The alternative of dominion does not lie between an aristarchy and a demarchy, that is to say, between an aristocratic and a democratic oligarchy. The chief business of the aristarchy is to persuade the

king, emperor, or czar, that he wants to go the way they wish him to go; that of the demarchy is to do the like with the mob.

[7] This view of the law of nature comes from the jurists. Hobbes defines it in the same way, but he says that, in the state of nature, the Law of Nature is silent. In speaking of Locke as the founder and father of individualism, I do not forget that Hooker (to whom Locke often refers), and still earlier writers, have expressed individualistic opinions. Nevertheless, I believe that modern Individualism is essentially Locke's work.

[8] Yet Locke, of course, knows well enough that children are not born equal and that adults are extremely unequal. All that he really means is that men have an "equal right to natural freedom," and that is a mere *a priori* dictum (§54-87). The sceptics as to the reality of the state of nature are treated with some contempt (§ 14). "It is often asked as a weighty objection, Where are, or ever were there, any such men in a state of nature? To which it may suffice as an answer at present, that since all princes and rulers of independent governments, all through the world, are in a state of nature, it is plain that the world never was, or ever will be, without numbers of men in that state. I have named all governors of independent communities, whether they are or are not in league with others, for it is not every compact that puts an end to the state of nature between men, but only this one of agreeing together mutually to enter into one community and make one body politic; other promises and compacts men may make with one another, and yet still be in the state of nature. The promises and bargains for truck, &c., between the two men in the desert island mentioned by Garcilasso de la Vega, in his *History of Peru*, or between a Swiss and an Indian, in the woods of America, are binding to them though they are perfectly in a state of nature, in reference to one another: for truth and keeping of faith belongs to men as men, and not as members of society."

[9] The following passages complete the expression of Locke's meaning: "Political power, then, I take to be a right of making laws with penalties of death, and consequently of all less penalties, for the regulating and preserving of property, and of employing the force of the community in the execution of such laws and in the defence of the commonwealth from foreign injury; and all this only for the public good," (§ 3). "Government has no other end than the preservation of property" (§ 94). "The great and chief end, therefore, of men's uniting into commonwealths and putting themselves under government is the preservation of their property" (§ 124).

[10] The oldest recorded form of the rule, and that which has the most positive character, is contained in the command of the Jewish law, "Thou shalt love thy neighbour as thyself," (Leviticus xix. 18), (neighbour including "stranger that dwelleth with you," v. 34), which stands in the same relation to the individualistic maxim as Fraternity to Equity. The strength of Judaism as a social organisation has resided in its unflinching advocacy of freedom, within the law; equality, before the law; and fraternity, outside the law. I am not sure that, from the purely philosophical point of view, the form in which that great Jew, Spinoza, has stated the rule is not the best: "Desire nothing for yourself which you do not desire for others," (*nihi sibi appetere quod reliquis hominibus non cupiant*). (Ethics, iv. xviii.)

[11] *Droit Naturel,* chap. 5.

[12] Von Humboldt's essay was written in 1791; but views so little likely to be relished by the German governments of that day needed cautious enunciation, and only fragments appeared (under the auspices of Schiller) until 1852, when the treatise formed part of the posthumous edition of Von Humboldt's works. A translation, under the title of *The Sphere and Duties of Government* was published in 1854, by Dr. Chapman

(then as now, the editor of the *Westminster Review*), and became very well known in this country.

[13] *Der Einzige und sein Eigenthum*, by Max Stirner. I follow the account of the contents of the book given by Meyer, *Der Emancipationskampf des vierten Standes* (Ed. 2, 1882, pp. 36-44).

[14] *Dieu et l'Etat*, 1881.

[15] Let me remind the reader that I use "anarchy" in its philosophical sense. Heaven forbid that I should be supposed to suggest that Mr. Herbert and his friends have the remotest connection with those too "absolute" political philosophers who desire to add the force of dynamite to that of persuasion. It would be as reasonable to connect Monarchists with murder, on the strength of the proceedings of a Philip the Second, or a Lewis the Fourteenth.

[16] *The Right and Wrong of Compulsion by the State*, 1885.

[17] *Ibid.* p. 33.

[18] *The Right and Wrong of Compulsion by the State*, 1885, p. 22.

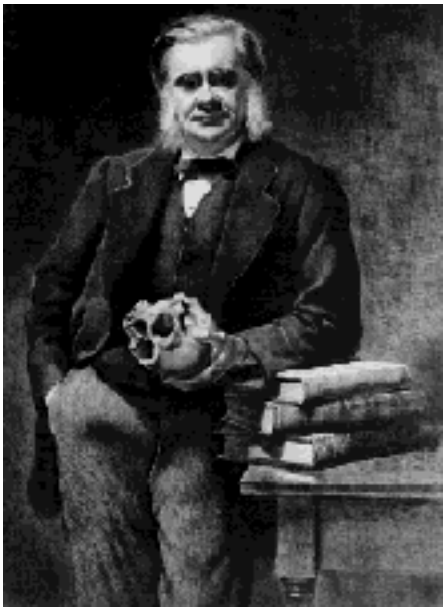
[19] *Individualism: a System of Politics*, 1889.

[20] The term "vital capital" is defined in an essay on "Capital and Labour" published in *The Nineteenth Century* (1890), which could not conveniently be included in this volume.

[21] Using the term in its more restricted sense.

[22] *Der geschlossene Handelsstaat*, 1899.

THE HUXLEY FILE



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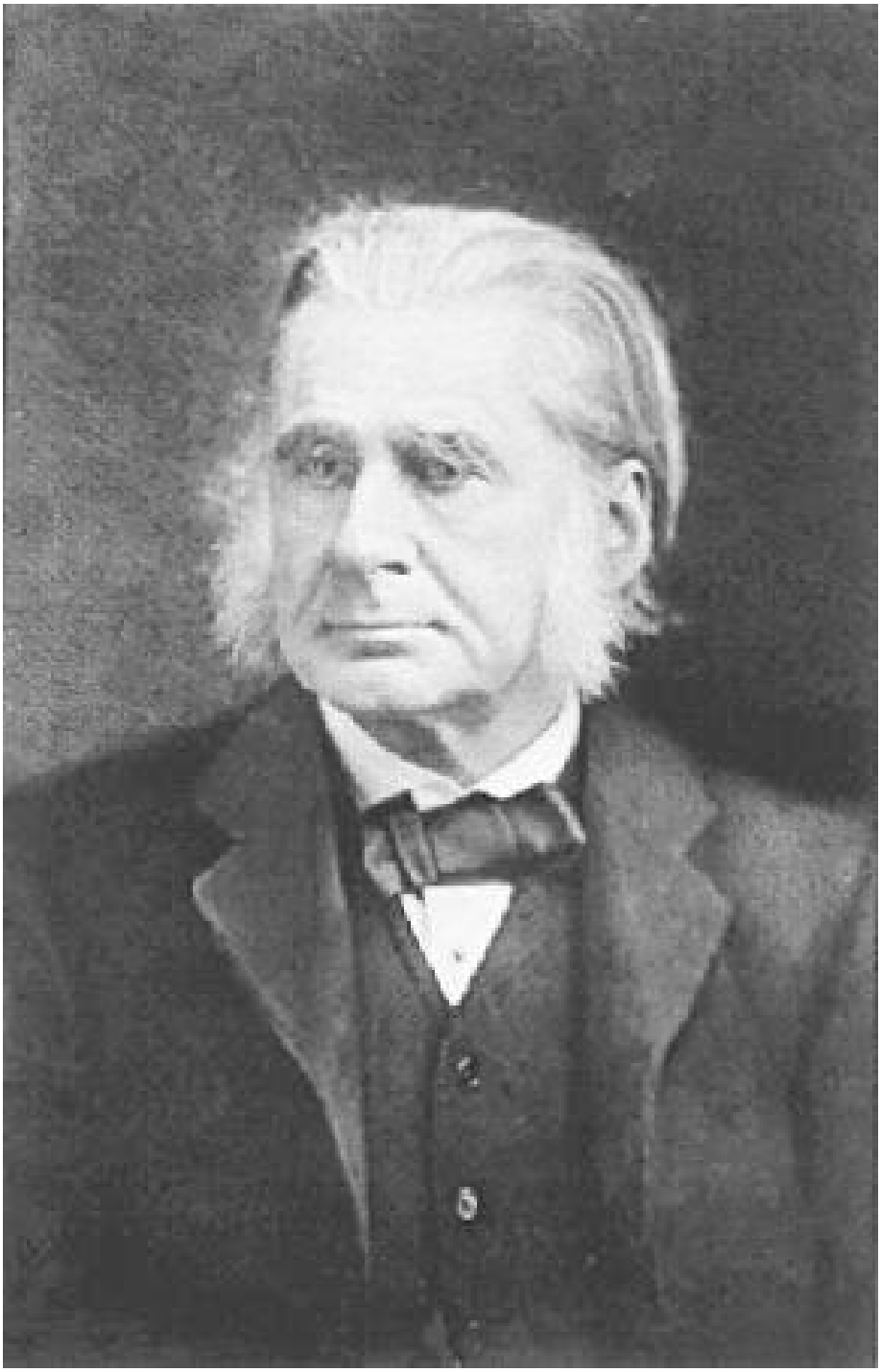
Previous article:Natural Rights and Political Rights [1890], pages 336-382.

Preface and Table of Contents to the next volume, Volume II of Huxley's *Collected Essays.*

C. Blinderman & D. Joyce
Clark University



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T. H. H. President of Royal Society

Photograph taken by W. & D. Downey, London

Appleton ed., Vol. II frontispeice

Preface II

Darwiniana

Hodeslea, Eastbourne.
April 7th, 1893.

[v] I have entitled this volume "Darwiniana" because the pieces republished in it either treat of the ancient doctrine of Evolution, rehabilitated and placed upon a sound scientific foundation, since and in consequence of, the publication of the "Origin of Species;" or they attempt to meet the more weighty of the unsparing criticisms with which that great work was visited for several years after its appearance; or they record the impression left by the personality of Mr. Darwin on one who had the privilege and the happiness of enjoying his friendship for some thirty years; or they endeavour to sum up his work and indicate its enduring influence on the course of scientific thought.

Those who take the trouble to read the first two essays, published in 1859 and 1860, will, I think, do me the justice to admit that my zeal to secure fair play for Mr. Darwin, did not drive me into the position of a mere advocate; and that, while doing justice to the greatness of the argu[vi]ment I did not fail to indicate its weak points. I have never seen any reason for departing from the position which I took up in these two essays; and the assertion which I sometimes meet with nowadays, that I have "recanted" or changed my opinions about Mr. Darwin's views, is quite unintelligible to me.

As I have said in the seventh essay, the fact of evolution is to my mind sufficiently evidenced by palæontology; and I remain of the opinion expressed in the second, that until selective breeding is definitely proved to give rise to varieties infertile with one another, the logical foundation of the theory of natural selection is incomplete. We still remain very much in the dark about the causes of variation; the apparent inheritance of acquired characters in some cases; and the struggle for existence within the organism, which probably lies at the bottom of both of these phenomena.

Some apology is due to the reader for the reproduction of the "Lectures to Working Men" in their original state. They were taken down in shorthand by Mr. J. Aldous Mays, who requested me to allow him to print them. I was very much pressed with work at the time; and, as I could not revise the reports, which I imagined, moreover, would be of little or no interest to any but my auditors, I stipulated that a notice should be prefixed to that effect. This was done; but it did not [vii]prevent a considerable diffusion of the little book in this country and in the United States, nor its translation into more than one foreign language. Moreover Mr. Darwin often urged me to revise and expand the lectures into a systematic popular exposition of the topics of which they treat. I have more than once set about the task: but the proverb about spoiling a horn and not making a spoon, is particularly applicable to attempts to remodel a piece of work which may have served its immediate purpose well enough.

So I have reprinted the lectures as they stand, with all their imperfections on their heads. It would seem that many people must have found them useful thirty years ago; and, though the sixties appear now to be

reckoned by many of the rising generation as a part of the dark ages, I am not without some grounds for suspecting that there yet remains a fair sprinkling even of "philosophic thinkers" to whom it may be a profitable, perhaps even a novel, task to descend from the heights of speculation and go over the A B C of the great biological problem as it was set before a body of shrewd artisans at that remote epoch.

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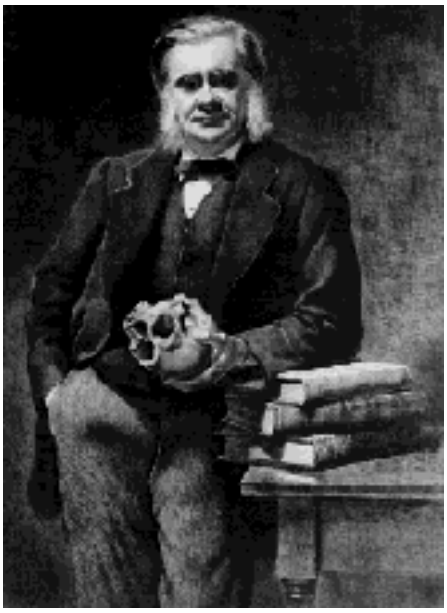

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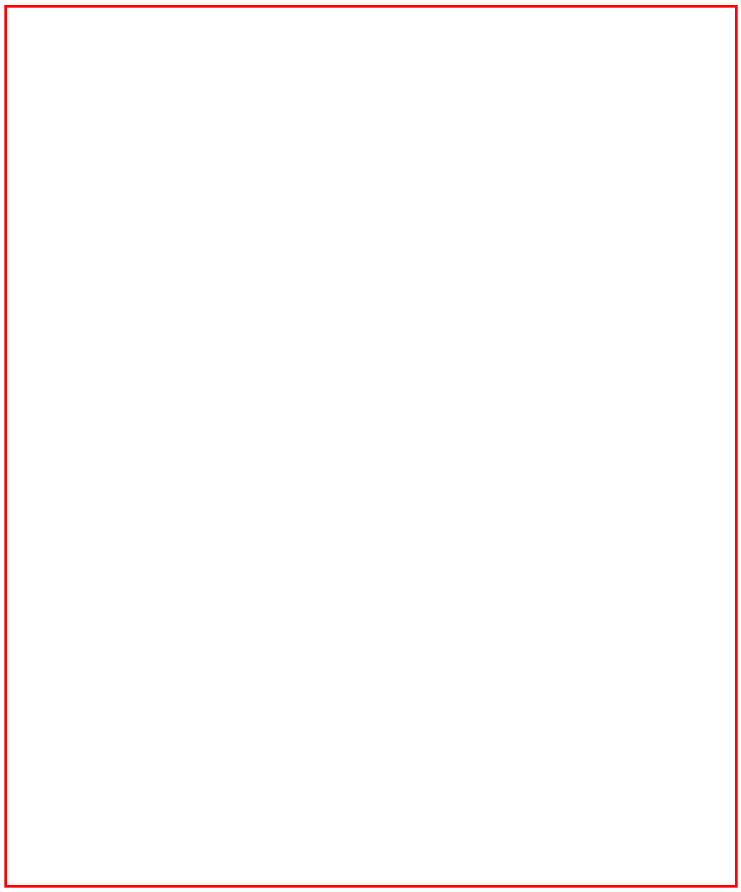

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Preface III

Science & Education

The apology offered in the Preface to the first volume of this series for the occurrence of repetitions, is even more needful here I am afraid. But it could hardly be otherwise with speeches and essays, on the same topic, addressed at intervals, during more than thirty years, to widely distant and different hearers and readers. The oldest piece, that "On the Educational Value of the Natural History Sciences," contains some crudities, which I repudiated when the lecture was first reprinted, more than twenty years ago; but it will be seen that much of what I have had to say, later on in life, is merely a development of the propositions enunciated in this early and sadly-imperfect piece of work.

In view of the recent attempt to disturb the compromise about the teaching of dogmatic theology, solemnly agreed to by the first School Board for London, the fifteenth Essay; and, more particularly, the note on p. 388, may be found interesting.

Hodeslea, Eastbourne.
September 4th, 1893.

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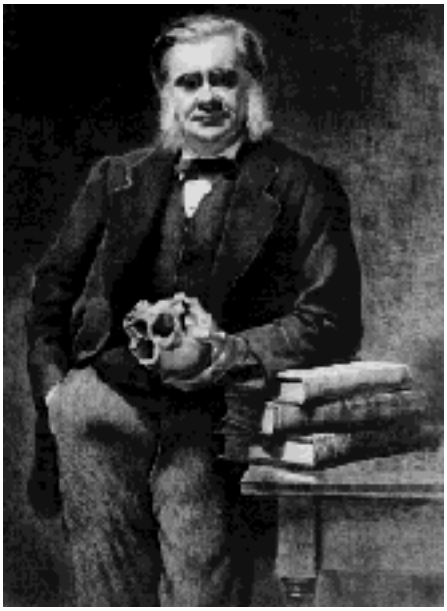

C. Blinderman & D. Joyce
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Three Generations

T. H. H., Leonard Huxley, and Julian Huxley

Appleton ed., Vol. IV frontispiece

Preface IV

Science and Hebrew Tradition

[v] For more than a thousand years, the great majority of the most highly civilised and instructed nations in the world have confidently believed and passionately maintained that certain writings, which they entitle sacred, occupy a unique position in literature, in that they possess an authority, different in kind, and immeasurably superior in weight, to that of all other books. Age after age, they have held it to be an indisputable truth that, whoever may be the ostensible writers of the Jewish, Christian, and Mahometan scriptures, God Himself is their real author; and, since their conception of the attributes of the Deity excludes the possibility of error and–at least in relation to this particular matter–of wilful deception, they have drawn the logical conclusion that the denier of the accuracy of any statement, the questioner of the binding force of any command, to be found in these documents is not merely a fool, but a blasphemer. From the point of view of mere reason he grossly blunders; from that of religion he grievously sins.

[vi] But, if this dogma of Rabbinical invention is well founded; if, for example, every word in our Bible has been dictated by the Deity;[1] or even, if it be held to be the Divine purpose that every proposition should be understood by the hearer or reader in the plain sense of the words employed (and it seems impossible to reconcile the Divine attribute of truthfulness with any other intention), a serious strain upon faith must arise. Moreover, experience has proved that the severity of this strain tends to increase, and in an even more rapid ratio, with the growth in intelligence of mankind and with the enlargement of the sphere of assured knowledge among them.

It is becoming, if it has not become, impossible for men of clear intellect and adequate instruction to believe, and it has ceased, or is ceasing, to be possible for such men honestly to say they believe, that the universe came into being in the fashion described in the first chapter of Genesis; or to accept, as a literal truth, the story of the making of woman, with the account of the catastrophe which followed hard upon it, in the second chapter; or to admit that the earth was re-peopled with terrestrial inhabitants by migration from [vii] Armenia or Kurdistan, little more than 4,000 years ago, which is implied in the eighth chapter; or finally, to shape their conduct in accordance with the conviction that the world is haunted by innumerable demons, who take possession of men and may be driven out of them by exorcistic adjurations, which pervades the Gospels.

Nevertheless, if there is any justification for the dogma of plenary inspiration, the damnatory prodigality of even the Athanasian Creed is still too sparing. "Whosoever will be saved" must believe, not only all these things, but a great many others of equal repugnancy to common sense and everyday knowledge.

The doctrine of biblical infallibility, which involves these remarkable consequences, was widely held by my countrymen within my recollection: I have reason to think that many persons of unimpeachable piety, a few of learning, and even some of intelligence, yet uphold it. But I venture to entertain a doubt whether it can produce any champion whose competency and authority would be recognised beyond the limits of the sect, or theological coterie, to which he belongs. On the contrary, apologetic effort, at

present, appears to devote itself to the end of keeping the name of "Inspiration" to suggest the divine source, and consequent infallibility, of more or less of the biblical literature, while carefully emptying the term of any definite sense. For "plenary inspiration" we are asked to substitute [viii] a sort of "inspiration with limited liability," the limit being susceptible of indefinite fluctuation in correspondence with the demands of scientific criticism. Where this advances that at once retreats.

This Parthian policy is carried out with some dexterity; but, like other such manœuvres in the face of a strong foe, it seems likely to end in disaster. It is easy to say, and sounds plausible, that the Bible was not meant to teach anything but ethics and religion, and that its utterances on other matters are mere *obiter dicta;* it is also a specious suggestion that inspiration, filtering through human brains, must undergo a kind of fallibility contamination; and that this human impurity is responsible for any errors, the existence of which has to be admitted, however unwillingly.

But how does the apologist know what the biblical writers intended to teach, and what they did not intend to teach? And even if their authority is restricted to matters of faith and morals, who is prepared to deny that the story of the fabrication of Eve, that of the lapse from innocence effected by a talking snake, that of the Deluge and the demonological legends, have exercised, and still exercise, a profound influence on Christian theology and Christian ethics? The very apologists who put forth this plea are never weary of declaring that the Divine authority for the moral law is the only safe foundation of ethics. But if [ix] several of the most important Pentateuchal narratives prove to be utterly unworthy of credit, what pretence is there for accepting other uncorroborated stories of a no less improbable character? If the writers of the gospels have taken fiction for truth, the survivals of pagan superstition for religion, in one department of spiritual knowledge, what guarantee have we for their infallibility in other departments? If the "human element" must be admitted to have already encroached so largely beyond the bounds, erstwhile thought to be set by Divine authority, what justification is there for imagining that any limit can be set to the discovery of further invasions?

The truth is that the pretension to infallibility, by whomsoever made, has done endless mischief; with impartial malignity it has proved a curse, alike to those who have made it and those who have accepted it; and its most baneful shape is book infallibility. For sacerdotal corporations and schools of philosophy are able, under due compulsion of opinion, to retreat from positions that have become untenable; while the dead hand of a book sets and stiffens, amidst texts and formulæ, until it becomes a mere petrifaction, fit only for that function of stumbling block, which it so admirably performs. Wherever bibliolatry has prevailed, bigotry and cruelty have accompanied it. It lies at the root of the deep-seated, sometimes disguised, but never absent, antagonism of all the varieties of ecclesiasticism to the freedom of thought and to the [x] spirit of scientific investigation. For those who look upon ignorance as one of the chief sources of evil; and hold veracity, not merely in act, but in thought, to be the one condition of true progress, whether moral or intellectual, it is clear that the biblical idol must go the way of all other idols. Of infallibility, in all shapes, lay or clerical, it is needful to iterate with more than Catonic pertinacity, *Delenda est.*

The essays contained in the present and the following volume are, for the most part, intended to contribute, in however slight a degree, to this process of deletion. Unless I greatly err, the arguments

adduced go a long way to prove that the accounts of the Creation and of the Deluge in the Hebrew scriptures are mere legends; and further, that the evidence for the existence and activity of a demonic world, implicitly and explicitly inculcated throughout the Christian scriptures, and universally held by the primitive Churches, is totally inadequate to justify the expression of belief in it.

This much on the negative side of the discussion. On the positive side, the essay on the "Evolution of Theology," as I imagine, shows cause for the conclusion that the Israelitic religion, in the earliest phase of which anything is really known, is neither more nor less rational, neither better nor worse ethically, than the religions of other nations in a similar state of [xi] civilisation; that, in the natural course of its evolution, it reached, in the prophetic age, an elevation and an ethical purity which have never been surpassed; and that, since the new birth of the prophetic spirit, in the first century of our era, the course of Christian dogmatic development, along its main lines, has been essentially retrogressive. The revived prophetic ideal was gradually overshadowed by the results of Jewish and Greek theological and metaphysical speculation, and buried beneath old-world superstitions and liturgical conjurations, gradually infiltrated from the pagan surroundings of the new religion; until, in the mediæval "ages of faith," it was well-nigh smothered beneath the monstrous agglomeration of spurious doctrines and idolatrous practices.

The ordinary reader, to whom these essays are addressed, will doubtless be surprised, if not shocked, at the many passages which expressly, or by implication, contradict the notions respecting the age and authority of the Hebrew scriptures, and especially of the Pentateuch, in which he has been brought up, and which have, quite recently, received high ecclesiastical sanction. "Helps to the Study of the Bible" are proffered to lay ignorance and simplicity, and those who hunger for trustworthy information will undoubtedly find much wholesome food in the banquet set forth by the Helpers. All the more pity that some of the bread is so very full of stones. For example, the [xii] commentary on the Pentateuch tells the student that Moses wrote or compiled the book of Genesis from documentary evidence extant in his time; that the book of Exodus was written by him, or under his immediate direction and authority; that the book of Leviticus, if not written by him, was compiled by authorised scribes under his supervision; that the book of Numbers was drawn up under his immediate oversight; that the book of Deuteronomy, containing the last addresses of the inspired legislator, specially recorded by official writers, assumed its present form under the hand of Joshua; and that the several books were enriched with numerous notes, archæological and explanatory, from the hands of later editors and revisers.[2]

Whether this view of the case implies plenary inspiration, or not, is more than I presume to say; nor do I wish to inquire whether there is, or is not, any rational foundation for it. The singularity that impresses me is the absence of the slightest hint to the ignorant layman that a large number of biblical scholars of the highest reputation, of undeniable competency and sincerity, repudiate every one of these propositions, and give an account of the origin of the Pentateuch, and of the age and authorship of its various constituents totally irreconcilable with it. There is no living biblical scholar who can ignore authorities of the [xiii] rank of Reuss and Wellhausen, of Robertson Smith and Kuenen, without gross presumption; I might even say without raising a serious doubt of his scientific integrity. But what is the general result of the patient study which these men, and many more such, have devoted, through long

years, to the elucidation of the difficult and complicated problem of the origin of the first five books of the Old Testament?

An excellent work, which has just made its appearance, supplies an answer. I may be permitted to say that it can hardly be ranked as a "shallow infidel" publication; not the last, insomuch as it is dedicated to the theological faculty of the University of Giessen; not the first, since its author, Dr. Smend, is a distinguished professor in the University of Göttingen.

After pointing out the importance of the question of the date of the priestly code (that is to say the so-called Levitical Law, which occupies so large a place in the books of Exodus, Leviticus, and Numbers), Dr. Smend says, it may now be considered to be proved, that this code "was first made known by Esra, about 444 B.C., and raised to the position of the fundamental law of Judaism. The kernel of the priestly code may be a few decades or even a century older; but it assuredly did not exist before Deuteronomy.... At the present day, it is almost universally admitted that there was no divine law book of [xiv] public authority in Israel before Josiah; especially, that the cultus and religious customs rested upon no divine law book; and that the chosen representatives of religion, before the exile, knew nothing whatever of such a law book.[3]

"Deuteronomy is the result of the reformatory movement set afoot by the Prophets. In fact, the Prophets, though unintentionally, became the founders of Judaism and its religion of legality. Therein lies their far-reaching historical influence. But the Prophets stand in complete antagonism to old Israel. They foretold the fall of kingdom and people, and so commenced a bitter warfare against the traditional conceptions of Israelitic religion. On the other hand, they were much more than founders of the Jewish community: they rise high above later Judaism; in them, the religion of the Old Testament substantially approaches Christianity" (*l. c.* p.9).

If I were to publish "Helps to the Study of Zoology" for popular use, in which the progress of science in the last fifty years was ignored and every recent authority passed over in silence, I am afraid, and indeed hope, that I should get into great trouble. But to be sure I should be judged by mere lay standards of right and wrong.

Hodeslea, Eastbourne
October 9th, 1893.

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[1] "Whoso says that Moses wrote even a single verse [of the Pentateuch] from his own knowledge, denies and contemns the Word of God," *bab Sanhedrin,* 99a, cited by Schürer, *Geschichte des Jüdischen Volkes,* Bd. II. p. 249. The account of the death of Moses in the last eight verses of Deuteronomy was, of course dictated to and written by himself, like all the rest. Admit prophetic inspiration and what becomes of the difficulty? Surely, a quite unanswerable argument.

[2] The Oxford Bible for Teachers, "*Helps to the Study of the Bible*," p. 10. New Edition, 1893.

[3] Smend, *Lehrbuch der Alttestamentlichen Religionsgeschichte*, 1893, p.8 (Sammlung Theologischer Lehrbücher.)

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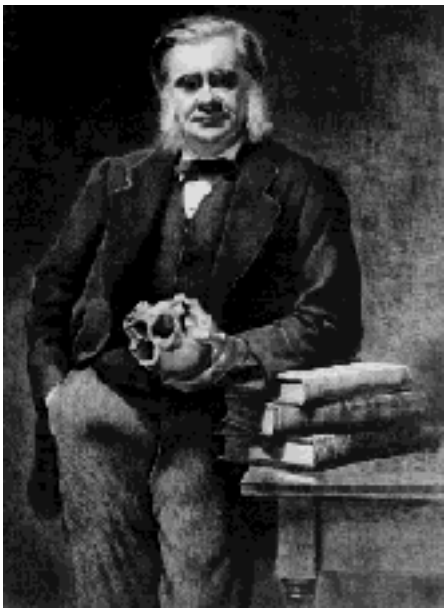

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Privy Huxley

T. H. H. in Privy Councillor Court Dress

Appleton ed., Vol V frontispiece

Preface V

Science and Christian Tradition

Hodeslea, Eastbourne
December 4th, 1893

[v] "For close upon forty years I have been writing with one purpose; from time to time, I have fought for that which seemed to me the truth, perhaps still more, against that which I have thought error; and in this way, I have

reached, indeed over-stepped, the threshold of old age. There, every earnest man has to listen to the voice within: 'Give an account of thy stewardship, for thou mayest be no longer steward.'

"That I have been an unjust steward my conscience does not bear witness. At times blundering, at times negligent, Heaven knows: but, on the whole, I have done that which I felt able and called upon to do: and I have done it without looking to the right or to the left; seeking no man's favour, fearing no man's disfavour.

"But what is it that I have been doing? In the end one's conceptions should form a whole, though only parts may have found utterance, as occasion arose; now do these exhibit harmony and mutual connexion? In one's zeal much of the old gets broken to pieces; but has one made ready something new, fit to be set in the place of the old?

"That they merely destroy without reconstructing, is the especial charge, with which those who work in this direction are constantly reproached. In a certain sense I do not defend myself against the charge; but I deny that any reproach is deserved.

"I have never proposed to myself to begin outward construction; because I do not believe that the time has come for it. Our present business is with inward preparation, especially the [vi] preparation of those who have ceased to be content with the old, and find no satisfaction in half measures. I have wished, and I still wish, to disturb no man's peace of mind, no man's beliefs; but only to point out to those in whom they are already shattered, the direction in which, in my conviction, firmer ground lies."[1]

So wrote one of the protagonists of the New Reformation–and a well-abused man if ever there was one–a score of years since, in the remarkable book in which he discusses the negative and the positive results of the rigorous application of scientific method to the investigation of the higher problems of human life.

Recent experience leads me to imagine that there may be a good many countrymen of my own, even at this time, to whom it may be profitable to read, mark and inwardly digest, the weighty words of the author of that "Leben Jesu," which, half a century ago, stirred the religious world so seriously that it has never settled down again quite on the old foundations; indeed, some think it never will. I have a personal interest in the carrying out of the recommendation I venture to make. It may enable many worthy persons, in whose estimation I should really be glad to stand higher than I do, to become aware of the possibility that my motives in writing the essays, contained in this and the preceding volume, were not exactly those that they ascribe to me.

[vii] I too have reached the term at which the still, small voice, more audible than any other to the dulled ear of age, makes its demand; and I have found that it is of no sort of use to try to cook the accounts rendered. Nevertheless, I distinctly decline to admit some of the items charged; more particularly that of having "gone out of my way" to attack the Bible; and I as steadfastly deny that "hatred of Christianity" is a feeling with which I have any acquaintance. There are very few things which I find it permissible to hate; and though, it may be, that some of the organisations, which arrogate to themselves the Christian name, have richly earned a place in the category of hateful things, that ought to have nothing to do with one's estimation of the religion, which they have perverted and disfigured out of all likeness to the

original.

The simple fact is that, as I have already more than once hinted, my story is that of the wolf and the lamb over again. I have never "gone out of my way" to attack the Bible, or anything else: it was the dominant ecclesiasticism of my early days, which, as I believe, without any warrant from the Bible itself, thrust the book in my way.

I had set out on a journey, with no other purpose than that of exploring a certain province of natural knowledge; I strayed no hair's breadth from the course which it was my right and my duty to pursue; and yet I found that, whatever [viii] route I took, before long, I came to a tall and formidable-looking fence. Confident as I might be in the existence of an ancient and indefeasible right of way, before me stood the thorny barrier with its comminatory notice-board–"No Thoroughfare. By order. Moses." There seemed no way over; nor did the prospect of creeping round, as I saw some do, attract me. True there was no longer any cause to fear the spring guns and man-traps set by former lords of the manor; but one is apt to get very dirty going on all-fours. The only alternatives were either to give up my journey–which I was not minded to do–or to break the fence down and go through it.

Now I was and am, by nature, a law-abiding person, ready and willing to submit to all legitimate authority. But I also had and have a rooted conviction, that reasonable assurance of the legitimacy should precede the submission; so I made it my business to look up the manorial title-deeds. The pretensions of the ecclesiastical "Moses" to exercise a control over the operations of the reasoning faculty in the search after truth, thirty centuries after his age, might be justifiable; but, assuredly, the credentials produced in justification of claims so large required careful scrutiny.

Singular discoveries rewarded my industry. The ecclesiastical "Moses" proved to be a mere traditional mask, behind which, no doubt, lay the features of the historical Moses–just as many a [ix] mediæval fresco has been hidden by the whitewash of Georgian churchwardens. And as the æsthetic rector too often scrapes away the defacement, only to find blurred, parti-colored patches, in which the original design is no longer to be traced; so, when the successive layers of Jewish and Christian traditional pigment, laid on, at intervals, for near three thousand years, had been removed, by even the tenderest critical operations, there was not much to be discerned of the leader of the Exodus.

Only one point became perfectly clear to me, namely, that Moses is not responsible for nine-tenths of the Pentateuch; certainly not for the legends which had been made the bugbears of science. In fact, the fence turned out to be a mere heap of dry sticks and brushwood, and one might walk through it with impunity: the which I did. But I was still young, when I thus ventured to assert my liberty; and young people are apt to be filled with a kind of *sæva indignatio,* when they discover the wide discrepancies between things as they seem and things as they are. It hurts their vanity to feel that they have prepared themselves for a mighty struggle to climb over, or break their way through, a rampart, which turns out, on close approach, to be a mere heap of ruins; venerable, indeed, and archæologically interesting, but of no other moment. And some fragment of the superfluous energy accumulated is apt to find vent in strong language.

[x] Such, I suppose, was my case, when I wrote some passages which occur in an essay reprinted among "Darwiniana."[2] But when, not long ago "the voice" put it to me, whether I had better not expunge, or modify, these passages; whether, really, they were not a little too strong; I had to reply, with all deference, that while, from a merely literary point of view, I might admit them to be rather crude, I must stand by the substance of these items of my expenditure. I further ventured to express the conviction that scientific criticism of the Old Testament, since 1860, has justified every word of the estimate of the authority of the ecclesiastical "Moses" written at that time. And, carried away by the heat of self-justification, I even ventured to add, that the desperate attempt now set afoot to force biblical and post-biblical mythology into elementary instruction, renders it useful and necessary to go on making a considerable outlay in the same direction. Not yet, has "the cosmogony of the semi-barbarous Hebrew" ceased to be the "incubus of the philosopher, and the opprobrium of the orthodox;" not yet, has "the zeal of the Bibliolater" ceased from troubling; not yet, are the weaker sort, even of the instructed, at rest from their fruitless toil "to harmonise impossibilities," and "to force the generous new wine of science into the old bottles of Judaism."

But I am aware that the head and front of my [xi] offending lies not now where it formerly lay. Thirty years ago, criticism of "Moses" was held by most respectable people to be deadly sin; now it has sunk to the rank of a mere peccadillo; at least, if it stops short of the history of Abraham. Destroy the foundation of most forms of dogmatic Christianity contained in the second chapter of Genesis, if you will; the new ecclesiasticism undertakes to underpin the superstructure and make it, at any rate to the eye, as firm as ever: but let him be anathema who applies exactly the same canons of criticism to the opening chapters of "Matthew" or of "Luke." School-children may be told that the world was by no means made in six days, and that implicit belief in the story of Noah's Ark is permissible only, as a matter of business, to their toy-makers; but they are to hold for the certainest of truths, to be doubted only at peril of their salvation, that their Galilean fellow-child Jesus, nineteen centuries ago, had no human father.

Well, we will pass the item of 1860, said "the voice." But why all this more recent coil about the Gadarene swine and the like? Do you pretend that these poor animals got in your way, years and years after the "Mosaic" fences were down, at any rate so far as you are concerned?

Got in my way? Why, my good "voice," they were driven in my way. I had happened to make a statement, than which, so far as I have [xii] ever been able to see, nothing can be more modest or inoffensive; to wit, that I am convinced of my own utter ignorance about a great number of things, respecting which the great majority of my neighbours (not only those of adult years, but children repeating their catechisms) affirm themselves to possess full information. I ask any candid and impartial judge, Is that attacking anybody or anything?

Yet, if I had made the most wanton and arrogant onslaught on the honest convictions of other people, I could not have been more hardly dealt with. The pentecostal charism, I believe, exhausted itself amongst the earliest disciples. Yet any one who has had to attend, as I have done, to copious objurgations, strewn with such appellations as "infidel" and "coward," must be a hardened sceptic indeed if he doubts the existence of a "gift of tongues" in the Churches of our time; unless, indeed, it should occur to him that

some of these outpourings may have taken place after "the third hour of the day." I am far from thinking that it is worth while to give much attention to these inevitable incidents of all controversies, in which one party has acquired the mental peculiarities which are generated by the habit of much talking, with immunity from criticism. But as a rule, they are the sauce of dishes of misrepresentations and inaccuracies which it may be a duty, nay, even an innocent pleasure, [xiv] to expose. In the particular case of which I am thinking, I felt, as Strauss says, "able and called upon" to undertake the business: and it is no responsibility of mine, if I found the Gospels, with their miraculous stories, of which the Gadarene is a typical example, blocking my way, as heretofore, the Pentateuch had done.

I was challenged to question the authority for the theory of "the spiritual world," and the practical consequences deducible from human relations to it, contained in these documents.

In my judgment, the actuality of this spiritual world–the value of the evidence for its objective existence and its influence upon the course of things–are matters, which lie as much within the province of science, as any other question about the existence and powers of the varied forms of living and conscious activity.

It really is my strong conviction that a man has no more right to say he believes this world is haunted by swarms of evil spirits, without being able to produce satisfactory evidence of the fact, than he has a right to say, without adducing adequate proof, that the circumpolar antarctic ice swarms with sea-serpents. I should not like to assert positively that it does not. I imagine that no cautious biologist would say as much; but while quite open to conviction, he might properly decline to waste time upon the consideration of talk, no better accredited than forecastle "yarns," about such monsters of the deep. And if the interests of ordinary veracity dictate this course, in relation to a matter of so little consequence as this, what must be our obligations in respect of the treatment of a question which is fundamental alike for science and for ethics? For not only does our general theory of the universe and of the nature of the order which pervades it, hang upon the answer; but the rules of practical life must be deeply affected by it.

The belief in a demonic world is inculcated throughout the Gospels and the rest of the books of the New Testament; it pervades the whole patristic literature; it colours the theory and the practice of every Christian church down to modern times. Indeed, I doubt, if even now, there is any church which, officially, departs from such a fundamental doctrine of primitive Christianity as the existence, in addition to the Cosmos with which natural knowledge is conversant, of a world of spirits; that is to say, of intelligent agents, not subject to the physical or mental limitations of humanity, but nevertheless competent to interfere, to an undefined extent, with the ordinary course of both physical and mental phenomena.

More especially is this conception fundamental for the authors of the Gospels. Without the belief that the present world, and particularly that part of it which is constituted by human society, has been given over, since the Fall, to the influence [xv] of wicked and malignant spiritual beings, governed and directed by a supreme devil–the moral antithesis and enemy of the supreme God–their theory of salvation by the

Messiah falls to pieces, "To this end was the Son of God manifested, that he might destroy the works of the devil."[3]

The half-hearted religiosity of latter-day Christianity may choose to ignore the fact; but it remains none the less true, that he who refuses to accept the demonology of the Gospels rejects the revelation of a spiritual world, made in them, as much as if he denied the existence of such a person as Jesus of Nazareth; and deserves, as much as any one can do, to be ear-marked "infidel" by our gentle shepherds.

Now that which I thought it, desirable to make perfectly clear, on my own account, and for the sake of those who find their capacity of belief in the Gospel theory of the universe failing them, is the fact, that, in my judgment, the demonology of primitive Christianity is totally devoid of foundation; and that no man, who is guided by the rules of investigation which are found to lead to the discovery of truth in other matters, not merely of science, but in the everyday affairs of life, will arrive at any other conclusion. To those who profess to be otherwise guided, I have nothing [xvi] to say; but to beg them to go their own way and leave me to mine.

I think it may be as well to repeat what I have said, over and over again, elsewhere, that *a priori* notions, about the possibility, or the impossibility, of the existence of a world of spirits, such as that presupposed by genuine Christianity, have no influence on my mind. The question for me is purely one of evidence: is the evidence adequate to bear out the theory, or is it not? In my judgment it is not only inadequate, but quite absurdly insufficient. And on that ground, I should feel compelled to reject the theory; even if there were no positive grounds for adopting a totally different conception of the Cosmos.

For most people, the question of the evidence of the existence of a demonic world, in the long run, resolves itself into that of the trustworthiness of the Gospels; first, as to the objective truth of that which they narrate on this topic; second, as to the accuracy of the interpretation which their authors put upon these objective facts. For example, with respect to the Gadarene miracle, it is one question whether, at a certain time and place, a raving madman became sane, and a herd of swine rushed into the lake of Tiberias; and quite another, whether the cause of these occurrences was the transmigration of certain devils from the man into the pigs. And again, it is one question whether Jesus made a long oration on a [xvii] certain occasion, mentioned in the first Gospel; altogether another, whether more or fewer of the propositions contained in the "Sermon on the Mount" were uttered on that occasion. One may give an affirmative answer to one of each of these pairs of questions and a negative to the other: one may affirm all, or deny all.

In considering the historical value of any four documents, proof when they were written and who wrote them is, no doubt, highly important. For if proof exists, that A B C and D wrote them, and that they were intelligent persons, writing independently and without prejudice, about facts within their own knowledge–their statements must need be worthy of the most attentive consideration.[4] But, even ecclesiastical tradition does not assert that either "Mark" or "Luke" wrote from his own knowledge–indeed "Luke" expressly asserts he did not. I cannot discover that any competent authority now maintains that the apostle Matthew wrote the Gospel which passes under his name. And whether

the apostle John had, or had not, anything to do with the fourth Gospel; and if he had, what his share amounted to; are, as everybody who has attended to these matters knows, questions still hotly disputed, and with regard to which the extant evidence can [xviii] hardly carry no impartial judge beyond the admission of a possibility this way or that.

Thus, nothing but a balancing of very dubious probabilities is to be attained by approaching the question from this side. It is otherwise if we make the documents tell their own story: if we study them, as we study fossils, to discover internal evidence of when they arose, and how they have come to be. That really fruitful line of inquiry has led to the statement and the discussion of what is known as the *Synoptic Problem.*

In the Essays (VII.–XI.) which deal with the consequences of the application of the agnostic principle to Christian Evidences, contained in this volume, there are several references to the results of the attempts which have been made, during the last hundred years, to solve this problem. And, though it has been clearly stated and discussed, in works accessible to, and intelligible by, every English reader,[5] it may be well that I should here set forth a very brief exposition of the matters of fact out of which the problem has arisen; and of some consequences, which, as I conceive, must be admitted if the facts are accepted.

These undisputed and, apparently, indisputable data may be thus stated:

I. The three books of which an ancient, but [xix] very questionable, ecclesiastical tradition asserts Matthew, Mark, and Luke to be the authors, agree, not only in presenting the same general view, or *Synopsis,* of the nature and the order of the events narrated; but, to a remarkable extent, the very words which they employ coincide.

II. Nevertheless, there are many equally marked, and some irreconcilable, differences between them. Narratives, verbally identical in some portions, diverge more or less in others. The order in which they occur in one, or in two, Gospels may be changed in another. In "Matthew" and in "Luke" events of great importance make their appearance, where the story of "Mark" seems to leave no place for them; and, at the beginning and the end of the two former Gospels, there is a great amount of matter of which there is no trace in "Mark."

III. Obvious and highly important differences, in style and substance, separate the three "Synoptics," taken together, from the fourth Gospel, connected, by ecclesiastical tradition, with the name of the apostle John. In its philosophical proemium; in the conspicuous absence of exorcistic miracles; in the self-assertive theosophy of the long and diffuse monologues, which are so utterly unlike the brief and pregnant utterances of Jesus recorded in the Synoptics; in the assertion that the crucifixion took place before the Passover, which involves the denial, by implication, of the truth of the Synoptic story–to mention only a few particulars–the "Johannine" Gospel presents a wide divergence from the other three.

IV. If the mutual resemblances and differences of the Synoptic Gospels are closely considered, a curious result comes out; namely, that each may be analyzed into four components. The *first* of these consists of

passages, to a greater or less extent verbally identical, which occur in all three Gospels. If this triple tradition is separated from the rest it will be found to comprise:

a. A narrative, of a somewhat broken and anecdotic aspect, which covers the period from the appearance of John the Baptist to the discovery of the emptiness of the tomb, on the first day of the week, some six-and-thirty hours after the crucifixion.

b. An apocalyptic address.

c. Parables and brief discourses, or rather centos of religious and ethical exhortations and injunctions.

The *second* and the *third* set of components of each Gospel present equally close resemblances to passages, which are found in only one of the other Gospels; therefore it may be said that, for them, the tradition is double. The *fourth* component is peculiar to each Gospel; it is a single tradition and has no representative in the others.

To put the facts in another way: each Gospel [xxi] is composed of a *threefold tradition,* two *twofold traditions,* and one *peculiar tradition.* If the Gospels were the work of totally independent writers, it would follow that there are three witnesses for the statements in the first tradition; two for each of those in the second, and only one for those in the third.

V. If the reader will now take up that extremely instructive little book, Abbott and Rushbrooke's "Common Tradition" he will easily satisfy himself that "Mark" has the remarkable structure just described. Almost the whole of this Gospel consists of the first component; namely, the *threefold tradition.* But in chap. i. 23-28 he will discover an exorcistic story, not to be found in "Matthew," but repeated, often word for word, in "Luke." This, therefore, belongs to one of the *twofold traditions.* In chap. viii 1-10, on the other hand, there is a detailed account of the miracle of feeding the four thousand; which is closely repeated in "Matthew" xv. 32-39, but is not to be found in "Luke." This is an example of the other *twofold tradition,* possible in "Mark." Finally, the story of the blind man of Bethsaida, "Mark" viii. 22-26, is *peculiar* to "Mark."

VI. Suppose that, A standing for the *threefold tradition,* or the matter common to all three Gospels; we call the matter common to "Mark" [xxii] and "Matthew" only–B; that common to "Mark" and "Luke" only–C; that common to "Matthew" and "Luke" only–D; while the peculiar components of "Mark," "Matthew," and "Luke" are severally indicated by E, F, G; then the structure of the Gospels may be represented thus:

Components of	"Mark"	= A + B + C + E.
"	"Matthew"	= A + B + D + F.
"	"Luke"	= A + C + D + G.

VII. The analysis of the Synoptic documents need be carried no further than this point, in order to suggest one extremely important, and, apparently unavoidable conclusion; and that is, that their authors were neither three independent witnesses of the things narrated; nor, for the parts of the narrative about which all agree, that is to say, the *threefold tradition*, did they employ independent sources of information. It is simply incredible that each of three independent witnesses of any series of occurrences should tell a story so similar, not only in arrangement and in small details, but in words, to that of each of the others.

Hence it follows, either that the Synoptic writers have, mediately or immediately, copied one from the other: or that the three have drawn from a common source; that is to say, from one arrangement of similar traditions (whether oral or written); though that arrangement may have [xxiii] been extant in three or more, somewhat different versions.

VIII. The suppositions (*a*) that "Mark" had "Matthew" and "Luke" before him; and (*b*) that either of the two latter was acquainted with the work of the other, would seem to involve some singular consequences.

a. The second Gospel is saturated with the lowest supernaturalism. Jesus is exhibited as a wonder-worker and exorcist of the first rank. The earliest public recognition of the Messiahship of Jesus comes from an "unclean spirit"; he himself is made to testify to the occurrence of the miraculous feeding twice over.

The purpose with which "Mark" sets out is to show forth Jesus as the Son of God, and it is suggested, if not distinctly stated, that he acquired this character at his baptism by John. The absence of any reference to the miraculous events of the infancy, detailed by "Matthew" and "Luke;" or to the appearances after the discovery of the emptiness of the tomb; is unintelligible, if "Mark" knew anything about them, or believed in the miraculous conception. The second Gospel is no summary: "Mark" can find room for the detailed story, irrelevant to his main purpose, of the beheading of John the Baptist, and his miraculous narrations are crowded with minute particulars. Is it to be imagined that, with the supposed apostolic authority of Matthew [xxiv] before him, he could leave out the miraculous conception of Jesus and the ascension? Further ecclesiastical tradition would have us believe that Mark wrote down his recollections of what Peter taught. Did Peter then omit to mention these matters? Did the fact testified by the oldest authority extant, that the first appearance of the risen Jesus was to himself seem not worth mentioning? Did he really fail to speak of the great position in the Church solemnly assigned to him by Jesus? The alternative would seem to be the impeachment either of Mark's memory, or of his judgment. But Mark's memory, is so good that he can recollect how, on the occasion of the stilling of the waves, Jesus was asleep "on the cushion," he remembers that the woman with the issue had "spent all she had" on her physicians; that there was not room "even about the door" on a certain occasion at Capernaum. And it is surely hard to believe that "Mark" should have failed to recollect occurrences of infinitely greater moment, or that he should have deliberately left them out, as things not worthy of mention.

b. The supposition that "Matthew" was acquainted with "Luke," or "Luke" with "Matthew" has equally grave implications. If that be so, the one who used the other could have had but a poor opinion of his

predecessor's historical veracity. If, as most experts agree, "Luke" is later than "Matthew," it is clear that he does [xxv] not credit "Matthew's" account of the infancy; does not believe the "Sermon on the Mount" as given by Matthew was preached; does not believe in the two feeding miracles, to which Jesus himself is made to refer; wholly discredits "Matthew's" account of the events after the crucifixion; and thinks it not worth while to notice "Matthew's" grave admission that "some doubted."

IX. None of these troublesome consequences pursue the hypothesis that the *threefold tradition*, in one, or more, Greek versions, was extant before either of the canonical Synoptic Gospels; and that it furnished the fundamental framework of their several narratives. Where and when the threefold narrative arose, there is no positive evidence; though it is obviously probable that the traditions it embodies, and perhaps many others, took their rise in Palestine and spread thence to Asia Minor, Greece, Egypt and Italy, in the track of the early missionaries. Nor is it less likely that they formed part of the "didaskalia" of the primitive Nazarene and Christian communities.[6]

X. The interest which attaches to "Mark" arises from the fact that it seems to present this [xxvi] early, probably earliest, Greek Gospel narrative, with least addition, or modification. If, as appears likely from some internal evidences, it was compiled for the use of the Christian sodalities in Rome; and that it was accepted by them as an adequate account of the life and work of Jesus, it is evidence of the most valuable kind respecting their beliefs and the limits of dogma, as conceived by them.

In such case, a good Roman Christian of that epoch might know nothing of the doctrine of the incarnation, as taught by "Matthew" and "Luke"; still less of the "logos" doctrine of "John"; neither need he have believed anything more than the simple fact of the resurrection. It was open to him to believe it either corporeal, or spiritual. He would never have heard of the power of the keys bestowed upon Peter; nor have had brought to his mind so much as a suggestion of trinitarian doctrine. He might be a rigidly monotheistic Judeo-Christian, and consider himself bound by the law: he might be a Gentile Pauline convert, neither knowing of nor caring for such restrictions. In neither case would he find in "Mark" any serious stumbling-block. In fact, persons of all the categories admitted to salvation by Justin, in the middle of the second century,[7] could accept "Mark" from beginning to end. It may well be, that, in this wide adaptability, backed by [xxvii] the authority of the metropolitan church, there lies the reason for the fact of the preservation of "Mark," notwithstanding its limited and dogmatically colourless character, as compared with the Gospels of "Luke" and "Matthew."

XI. "Mark," as we have seen, contains a relatively small body of ethical and religious instruction and only a few parables. Were these all that existed in the primitive threefold tradition? Were none others current in the Roman communities, at the time "Mark" wrote, supposing he wrote in Rome? Or, on the other hand, was there extant, as early as the time at which "Mark" composed his Greek edition of the primitive Evangel, one or more collections of parables and teachings, such as those which form the bulk of the twofold tradition, common exclusively to "Matthew" and "Luke," and are also found in their single traditions? Many have assumed this, or these, collections to be identical with, or at any rate based upon, the "logia," of which ecclesiastical tradition says, that they were written in Aramaic by Matthew, and that everybody translated them as he could.

Here is the old difficulty again. If such materials were known to "Mark," what imaginable reason could he have for not using them? Surely displacement of the long episode of John the Baptist–even perhaps of the story of the Gadarene swine–by portions of the Sermon on the Mount or [xxviii] by one or two of the beautiful parables in the twofold and single traditions would have been great improvements; and might have been effected, even though "Mark" was as much pressed for space as some have imagined. But there is no ground for that imagination; Mark has actually found room for four or five parables; why should he not have given the best, if he had known of them? Admitting he was the mere *pedissequus et breviator* of Matthew, that even Augustine supposed him to be, what could induce him to omit the Lord's Prayer?

Whether more or less of the materials of the twofold tradition D, and of the peculiar traditions F and G, were or were not current in some of the communities, as early as, or perhaps earlier than, the triple tradition, it is not necessary for me to discuss; nor to consider those solutions of the Synoptic problem which assume that it existed earlier, and was already combined with more or less narrative. Those who are working out the final solution of the Synoptic problem are taking into account, more than hitherto, the possibility that the widely separated Christian communities of Palestine, Asia Minor, Egypt, and Italy, especially after the Jewish war of A.D. 66-70, may have found themselves in possession of very different traditional materials. Many circumstances tend to the conclusion that, in Asia Minor, even the narrative part of the threefold tradition had a formidable [xxix] rival; and that, around this second narrative, teaching traditions of a totally different order from those in the Synoptics, grouped themselves; and, under the influence of converts imbued more or less with the philosophical speculations of the time, eventually took shape in the fourth Gospel and its associated literature.

XII. But it is unnecessary, and it would be out of place, for me to attempt to do more than indicate the existence of these complex and difficult questions. My purpose has been to make it clear that the Synoptic problem must force itself upon every one who studies the Gospels with attention; that the broad facts of the case, and some of the consequences deducible from these facts, are just as plain to the simple English reader as they are to the profoundest scholar.

One of these consequences is that the threefold tradition presents us with a narrative believed to be historically true, in all particulars, by the major part, if not the whole, of the Christian communities. That narrative is penetrated, from beginning to end, by the demonological beliefs of which the Gadarene story is a specimen; and, if the fourth Gospel indicates the existence of another and, in some respects, irreconcilably divergent narrative, in which the demonology retires into the background, it is none the less there.

Therefore, the demonology is an integral and inseparable component of primitive Christianity. [xxx] The farther back the origin of the gospels is dated, the stronger does the certainty of this conclusion grow; and the more difficult it becomes to suppose that Jesus himself may not have shared the superstitious beliefs of his disciples.

It further follows that those who accept devils, possession, and exorcism as essential elements of their

conception of the spiritual world may consistently consider the testimony of the Gospels to be unimpeachable in respect of the information they give us respecting other matters which appertain to that world.

Those who reject the gospel demonology, on the other hand, would seem to be as completely barred, as I feel myself to be, from professing to take the accuracy of that information for granted. If the threefold tradition is wrong about one fundamental topic, it may be wrong about another, while the authority of the single traditions, often mutually contradictory as they are, becomes a vanishing quantity.

It really is unreasonable to ask any rejector of the demonology to say more with respect to those other matters, than that the statements regarding them may be true, or may be false; and that the ultimate decision, if it is to be favourable, must depend on the production of testimony of a very different character from that of the writers of the four gospels. Until such evidence is brought forward, that refusal of assent, with willingness to [xxxi] re-open the question, on cause shown, which is what I mean by Agnosticism, is, for me the only course open.

A verdict of "not proven" is undoubtedly unsatisfactory and essentially provisional, so far forth as the subject of the trial is capable of being dealt with by due process of reason.

Those who are of opinion that the historical realities at the root of Christianity, lie beyond the jurisdiction of science, need not be considered. Those who are convinced that the evidence is, and must always remain, insufficient to support any definite conclusion, are justified in ignoring the subject. They must be content to put up with that reproach of being mere destroyers, of which Strauss speaks. They may say that there are so many problems which are and must remain insoluble, that the "burden of the mystery" "of all this unintelligible world" is not appreciably affected by one more or less.

For myself, I must confess that the problem of the origin of such very remarkable historical phenomena as the doctrines, and the social organization, which, in their broad features certainly existed, and were in a state of rapid development, within a hundred years of the crucifixion of Jesus; and which have steadily prevailed against all rivals, among the most intelligent and civilized nations in the world ever since, [xxxii] is, and always has been, profoundly interesting; and, considering how recent the really scientific study of that problem, and how great the progress made during the last half century in supplying the conditions for a positive solution of the problem, I cannot doubt that the attainment of such a solution is a mere question of time.

I am well aware that it has lain far beyond my powers to take any share in this great undertaking. All that I can hope is to have done somewhat towards "the preparation of those who have ceased to be contented with the old and find no satisfaction in half measures": perhaps, also, something towards the lessening of that great proportion of my countrymen, whose eminent characteristic it is that they find full "full satisfaction in half measures."

[1] D. F. Strauss, *Der alte und der neue Glaube,* (1872), pp. 9-10.

[2] *Collected Essays,* vol. ii., "On the Origin of Species" (1860).

[3] 1 John iii. 8.

[4] Not necessarily of more than this. A few centuries ago the twelve most intelligent and impartial men to be found in England, would have independently testified that the sun moves, from east to west, across the heavens every day.

[5] Nowhere more concisely and clearly than in Dr. Sutherland Black's article "Gospels" in Chambers's *Encyclopædia* . References are given to the more elaborate discussions of the problem.

[6] Those who regard the Apocalyptic discourse as a "vaticination after the event" may draw conclusions therefrom as to the date of the Gospels in which its several forms occur. But the assumption is surely dangerous, from an apologetlc point of view, since it begs the question as to the unhistorical character of this solemn prophecy.

[7] See p. 287 of this volume.

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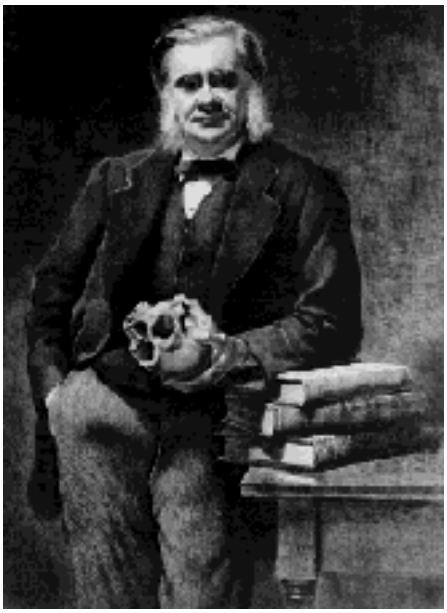

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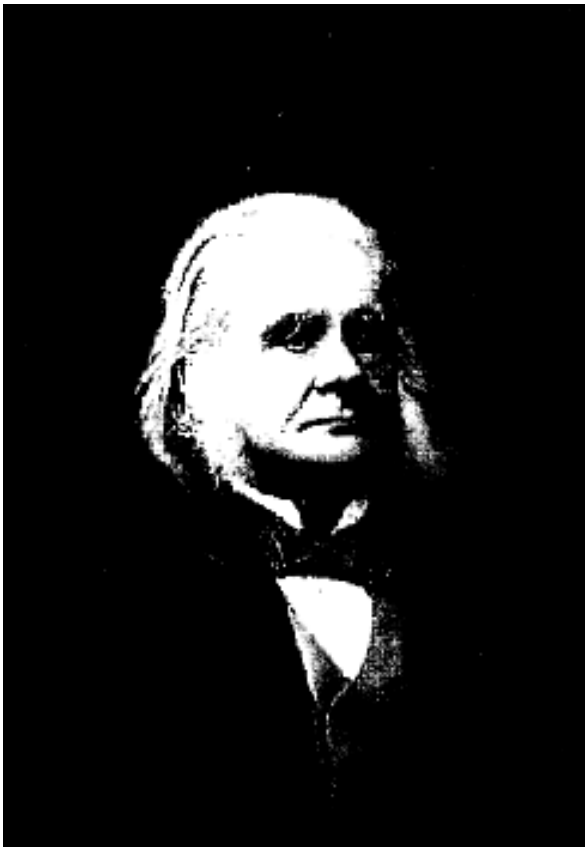

Philosophical T. H. H.

Appleton ed., Vol VI frontispiece

Preface VI

Hume: With Helps to the Study of Berkeley

Hodeslea, Eastbourne
January, 1894

[v] In two essays[a,b] upon the life and work of Descartes, which will be found in the first volume of this collection, I have given some reasons for my conviction that he, if any one, has a claim to the title of father of modern philosophy. By this I mean that his general scheme of things, his conceptions of scientific method and of the conditions and limits of certainty, are far more essentially and characteristically modern than those of any of his immediate predecessors and successors. Indeed, the adepts in some branches of science had not fully mastered the import of his ideas so late as the beginning of this century.

The conditions of this remarkable position in the world of thought are to be found, as usual, primarily, in mother-wit, secondarily, in circumstance. Trained by the best educators of the seventeenth century, the Jesuits; naturally endowed with a dialectic grasp and subtlety, which even they could [vi] hardly improve; and with a passion for getting at the truth, which even they could hardly impair, Descartes possessed, in addition, a rare mastery of the art of literary expression. If the "Discours de la Méthode" had no other merits, it would be worth study for the sake of the luminous simplicity and sincerity of its style.

A mathematician of the very first rank, Descartes knew all that was to be known of mechanical and optical science in his day; he was a skilled and zealous practical anatomist; he was one of the first to recognise the prodigious importance of the discovery of his contemporary Harvey; and he penetrated more deeply into the physiology of the nervous system than any specialist in that science, for a century, or more, after his time. To this encyclopædic and yet first-hand acquaintance with the nature of things, he added an acquaintance with the nature of men (which is a much more valuable chapter of experience to philosophers than is commonly imagined), gathered in the opening campaigns of the Thirty Years' War, in wide travels, and amidst that brilliant French society in which Pascal was his worthy peer. Even a "Traite des Passions," to be worth anything, must be based upon observation and experiment; and, in this subject, facilities for laboratory practice of the most varied and extensive character were offered by the Paris of Mazarin and the Duchesses; the Paris, in which Descartes' great friend and ally, Father Mersenne, reckoned atheists by the thousand; and, in which, [vii] political life touched the lowest depths of degradation, amidst the chaotic personal intrigues of the Fronde. Thus endowed, thus nurtured, thus tempered in the fires of experience, it is intelligible enough that a resolute, clear-headed man, haunted from his youth up, as he tells us, with an extreme desire to learn how to distinguish truth from falsehood, in order to see his way clearly and walk surely through life,[1] should have early come to the conclusion, that the first thing to be done was to cast aside, at any rate temporarily, the crutches of traditional, or other, authority; and stand upright on his own feet, trusting to no support but that of the solid ground of fact.

It was in 1619, while meditating in solitary winter quarters, that Descartes (being about the same age as Hume when he wrote the "Treatise on Human Nature") made that famous resolution, to "take nothing for truth without clear knowledge that it is such," the great practical effect of which is the sanctification of doubt; the recognition that the profession of belief in propositions, of the truth of which there is no sufficient evidence, is immoral; the discrowning of authority as such; the repudiation of the confusion, beloved of sophists of all sorts, between free assent and mere piously gagged dissent; and the admission of the obligation to reconsider even one's axioms on due demand.

These, if I mistake not, are the notes of the [viii] modern, as contrasted with the ancient spirit. It is true that the isolated greatness of Socrates was founded on intellectual and moral characteristics of the same order. He also persisted in demanding that no man should "take anything for truth without a clear knowledge that it is such," and so constantly and systematically shocked authority and shook traditional security, that the fact of his being allowed to live for seventy years, if one comes to think of it, is evidence of the patient and tolerant disposition of his Athenian compatriots, which should obliterate the

memory of the final hemlock. That which it may be well for us not to forget is, that the first-recorded judicial murder of a scientific thinker was compassed and effected, not by a despot, nor by priests, but was brought about by eloquent demagogues, to whom, of all men, thorough searchings of the intellect are most dangerous and therefore most hateful.

The first agnostic, the man who, so far as the records of history go, was the first to see that clear knowledge of what one does not know is just as important as knowing what one does know, had no true disciples; and the greatest of those who listened to him, if he preserved the fame of his master for all time, did his best to counteract the impulse towards intellectual clearness which Socrates gave. The Platonic philosophy is probably the grandest example of the unscientific use of the imagination extant; and it [ix] would be hard to estimate the amount of detriment to clear thinking effected, directly and indirectly, by the theory of ideas, on the one hand, and by the unfortunate doctrine of the baseness of matter, on the other.

Ancient thought, so far as it is positive, fails on account of its neglect to criticise its assumptions; so far as it is negative, it fails, because it forgets that proof of the inconsistencies of the terms in which we symbolise things has nothing to do with the cogency of the logic of facts. The negations of Pyrrhonism are as shallow, as the assumptions of Platonism are empty. Modern thought has by no means escaped from perversions of the same order. But, thanks to the sharp discipline of physical science, it is more and more freeing itself from them. In face of the incessant verification of deductive reasoning by experiment, Pyrrhonism has become ridiculous; in face of the ignominious fate which always befalls those who attempt to get at the secrets of nature, or the rules of conduct, by the high *a priori* road, Platonism and its modern progeny show themselves to be, at best, splendid follies.

The development of exact natural knowledge in all its vast range, from physics to history and criticism, is the consequence of the working out, in this province, of the resolution to "take nothing for truth without clear knowledge that it is such;" to consider all beliefs open to criticism; to regard [x] the value of authority as neither greater nor less, than as much as it can prove itself to be worth. The modern spirit is not the spirit "which always denies," delighting only in destruction; still less is it that which builds castles in the air rather than not construct; it is that spirit which works and will work "without haste and without rest," gathering harvest after harvest of truth into its barns and devouring error with unquenchable fire.

In the reform of philosophy, since Descartes, I think that the greatest and the most fruitful results of the activity of the modern spirit–it may be, the only great and lasting results–are those first presented in the works of Berkeley and of Hume.

The one carried out to its logical result the Cartesian principle, that absolute certainty attaches only to the knowledge of facts of consciousness; the other, extended the Cartesian criticism to the whole range of propositions commonly "taken for truth;" proved that, in a multitude of important instances, so far from possessing "clear knowledge" that they may be so taken, we have none at all; and that our duty therefore is to remain silent; or to express, at most, suspended judgment.

My earliest lesson on this topic was received from Hume's keen-witted countryman Hamilton; [xi] afterwards I learned it, more fully, from the fountain head, the "Discours de la Méthode"; then from Berkeley and from Hume themselves. So that when, in 1878, my friend Mr. John Morley asked me to write an account of Hume for the "English Men of Letters" series, I thought I might undertake the business, without too much presumption; also, with some hope of passing on to others the benefits which I had received from the study of Hume's works. And, however imperfect the attempt may be, I have reason to believe that it has fulfilled its purpose. I hoped, at one time, to be able to add an analogous exposition of Berkeley's views; and, indeed, undertook to supply it. But the burdens and distractions of a busy life led to the postponement of this, as of many other projects, till too late. My statement of Hume's philosophy will have to be provided with its counterpart and antithesis by other hands. But I have appended to the "Hume" a couple of preliminary studies, which may be of use to students of Berkeley.

One word, by way of parting advice to the rising generation of English readers. If it is your desire to discourse fluently and learnedly about philosophical questions, begin with the Ionians and work steadily through to the latest new speculative treatise. If you have a good memory and a fair knowledge of Greek, Latin, French, and [xii] German, three or four years spent in this way should enable you to attain your object,

If, on the contrary, you are animated by the much rarer desire for real knowledge; if you want to get a clear conception of the deepest problems set before the intellect of man, there is no need, so far as I can see, for you to go beyond the limits of the English tongue. Indeed, if you are pressed for time, three English authors will suffice; namely, Berkeley, Hume, and Hobbes.

If you will lay your minds alongside the works of these great writers–not with the view of merely ascertaining their opinions, still less for the purpose of indolently resting on their authority, but to the end of seeing for yourselves how far what each says has its foundation in right reason–you will have had as much sound philosophical training as is good for any one but an expert. And you will have had the further advantage of becoming familiar with the manner in which three of the greatest masters of the English language have handled that noble instrument of thought.

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[1] *Discours de la Méhode.* 1e Partie.

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Helps to the Study of Berkeley

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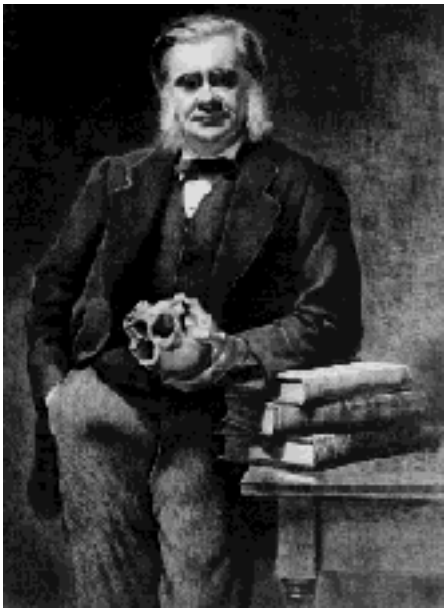

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C. Blinderman & D. Joyce
Clark University

T. H. H.'s Place in Nature 1874

Appleton ed., Vol VII frontispiece

Same as President of the B. A. A. S., in "Hair"

Preface VII (1894)

Man's Place in Nature

[v] I AM very well aware that the old are prone to regard their early performances with much more interest than their contemporaries of a younger generation are likely to take in them; moreover, I freely admit that my younger contemporaries might employ their time better than in perusing the three essays, written thirty-two years ago, which occupy the first place in this volume. This confession is the more needful, inasmuch as all the premisses of the argument set forth in "Man's Place in Nature" and most of the conclusions deduced from them, are now to be met with among other well-established and, indeed, elementary truths, in the text-books.

Paradoxical as the statement may seem, however, it is just because every well-informed student of biology ought to be tempted to throw these essays, and especially the second, "On the Relations of Man to the Lower Animals," aside, as a fair mathematician might dispense with the reperusal of Cocker's arithmetic, that I think it [vi] worth while to reprint them; and entertain the hope that the story of their origin and early fate may not be devoid of a certain antiquarian interest, even if it possess no other.

In 1854, it became my duty to teach the principles of biological science with especial reference to paleontology. The first result of addressing myself to the business I had taken in hand was the discovery of my own lamentable ignorance in respect of many parts of the vast field of knowledge through which I had undertaken to guide others. The second result was a resolution to amend this state of things to the best of my ability; to which end, I surveyed the ground; and having made out what were the main positions to be captured, I came to the conclusion that I must try to carry them by concentrating all the energy I possessed upon each in turn. So I set to work to know something of my own knowledge of all the various disciplines included under the head of Biology; and to acquaint myself, at first hand, with the evidence for and against the extant solutions of the greater problems of that science. I have reason to believe that wise heads were shaken over my apparent divagations–now into the province of Physiology or Histology, now into that of Comparative Anatomy, of Development, of Zoology, of Paleontology, or of Ethnology. But even at this time, when I am, or ought to be, so much wiser, I really do not see that I could have [vii] done better. And my method had this great advantage; it involved the certainty that somebody would profit by my effort to teach properly. Whatever my hearers might do, I myself always learned something by lecturing. And to those who have experience of what a heart-breaking business teaching is–how much the can't-learns and won't-learns and don't-learns predominate over the do-learns–will understand the comfort of that reflection.

Among the many problems which came under my consideration, the position of the human species in zoological classification was one of the most serious. Indeed, at that time, it was a burning question in the sense that those who touched it were almost certain to burn their fingers severely. It was not so very long since my kind friend Sir William Lawrence, one of the ablest men whom I have known, had been well-nigh ostracized for his book "On Man," which now might be read in a Sunday-school without surprising anybody; it was only a few years, since the electors to the chair of Natural History in a famous northern university had refused to invite a very distinguished man to occupy it because he advocated the doctrine of the diversity of species of mankind, or what was called "polygeny." Even among those who considered man from the point of view, not of vulgar prejudice, but of science, opinions lay poles asunder. Linnæus had taken one view, Cuvier [viii] another; and, among my senior contemporaries, men like Lyell, regarded by many as revolutionaries of the deepest dye, were strongly opposed to anything which tended to break down the barrier between man and the rest of the animal world.

My own mind was by no means definitely made up about this matter when, in the year 1857, a paper was read before the Linnæan Society "On the Characters, Principles of Division and Primary Groups of the Class Mammalia," in which certain anatomical features of the brain were said to be "peculiar to the genus *Homo*," and were made the chief ground for separating that genus from all other mammals, and placing him in a division "Archencephala," apart from, and superior to, all the rest. As these statements

did not agree with the opinions I had formed, I set to work to reinvestigate the subject; and soon satisfied myself that the structures in question were not peculiar to Man, but were shared by him with all the higher and many of the lower apes. I embarked in no public discussion of these matters; but my attention being thus drawn to them, I studied the whole question of the structural relations of Man to the next lower existing forms, with much care. And, of course, I embodied my conclusions in my teaching.

Matters were at this point, when "The Origin of Species" appeared. The weighty sentence "Light will be thrown on the origin of man and his [ix] history" (lst ed. p. 488) was not only in full harmony with the conclusions at which I had arrived, respecting the structural relations of apes and men, but was strongly supported by them. And inasmuch as Development and Vertebrate Anatomy were not among Mr. Darwin's many specialities, it appeared to me that I should not be intruding on the ground he had made his own, if I discussed this part of the general question. In fact, I thought that I might probably serve the cause of evolution by doing so.

Some experience of popular lecturing had convinced me that the necessity of making things plain to uninstructed people, was one of the very best means of clearing up the obscure corners in one's own mind. So, in 1860, I took the Relation of Man to the Lower Animals, for the subject of the six lectures to working men which it was my duty to deliver. It was also in 1860, that this topic was discussed before a jury of experts, at the meeting of the British Association at Oxford; and, from that time, a sort of running fight on the same subject was carried on, until it culminated at the Cambridge meeting of the Association in 1862, by my friend Sir W. Flower's public demonstration of the existence in the apes of those cerebral characters which had been said to be peculiar to man.

"Magna est veritas et prævalebit!" Truth is great, certainly, but, considering her greatness, it is [x] curious what a long time she is apt to take about prevailing. When, towards the end of 1862, I had finished writing "Man's Place in Nature," I could say with a good conscience, that my conclusions "had not been formed hastily or enunciated crudely." I thought I had earned the right to publish them and even fancied I might be thanked, rather than reproved, for so doing. However, in my anxiety to promulgate nothing erroneous, I asked a highly competent anatomist and very good friend of mine to look through my proofs and, if he could, point out any errors of fact. I was well pleased when he returned them without criticism on that score; but my satisfaction was speedily dashed by the very earnest warning, as to the consequences of publication, which my friend's interest in my welfare led him to give. But, as I have confessed elsewhere, when I was a young man, there was just a little–a mere *soupçon*– in my composition of that tenacity of purpose which has another name; and I felt sure that all the evil things prophesied would not be so painful to me as the giving up that which I had resolved to do, upon grounds which I conceived to be right. So the book came out; and I must do my friend the justice to say that his forecast was completely justified. The Boreas of criticism blew his hardest blasts of misrepresentation and ridicule for some years; and I was even as one of the [xi] wicked. Indeed, it surprises me, at times, to think how any one who had sunk so low could since have emerged into, at any rate, relative respectability. Personally, like the non-corvine personages in the Ingoldsby legend, I did not feel "one penny the worse." Translated into several languages, the book reached a wider public than I had ever hoped for; being largely helped, I imagine, by the Ernulphine advertisements to which I have referred. It has had the honour of being freely utilized, without acknowledgment, by writers of repute;

and, finally, it achieved the fate, which is the euthanasia of a scientific work, of being inclosed among the rubble of the foundations of later knowledge and forgotten.

To my observation, human nature has not sensibly changed during the last thirty years. I doubt not that there are truths as plainly obvious and as generally denied, as those contained in "Man's Place in Nature," now awaiting enunciation. If there is a young man of the present generation, who has taken as much trouble as I did to assure himself that they are truths, let him come out with them, without troubling his head about the barking of the dogs of St. Ernulphus. "Veritas prævalebit"–some day; and, even if she does not prevail in his time, he himself will be all the better and the wiser for having tried to help her. And let him recollect that such great [xii] reward is full payment for all his labour and pains.

"Man's Place in Nature," perhaps, may still be useful as an introduction to the subject; but, as any interest which attaches to it must be mainly historical, I have thought it right to leave the essays untouched. The history of the long controversy about the structure of the brain, following upon the second dissertation, in the original edition, however, is omitted. The verdict of science has long since been pronounced upon the questions at issue; and no good purpose can be served by preserving the memory of the details of the suit.

In many passages, the reader who is acquainted with the present state of science, will observe much room for addition; but, in all cases, the supplements required, are, I believe, either indifferent to the argument or would strengthen it.

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The first three Essays were published in January, 1863, under the title of "Man's Place in Nature"; the fourth essay appeared in the *Fortnightly Review*, the fifth in the *Contemporary Review*, and they were republished in *Critiques and Addresses.* The Essay on the Aryan Question appeared in the *Nineteenth Century* for November, 1890.

T. H. H. And blackboard friend

Wellcome Museum

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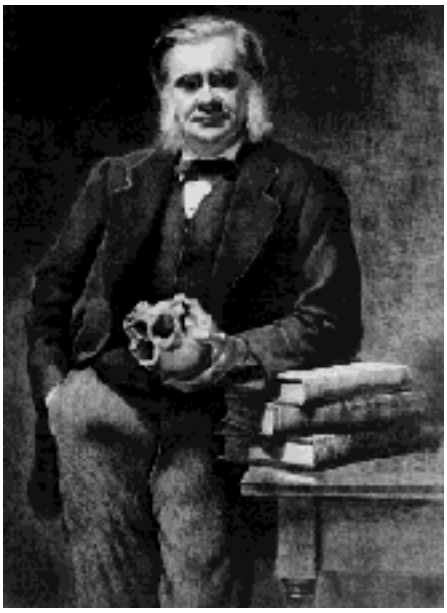

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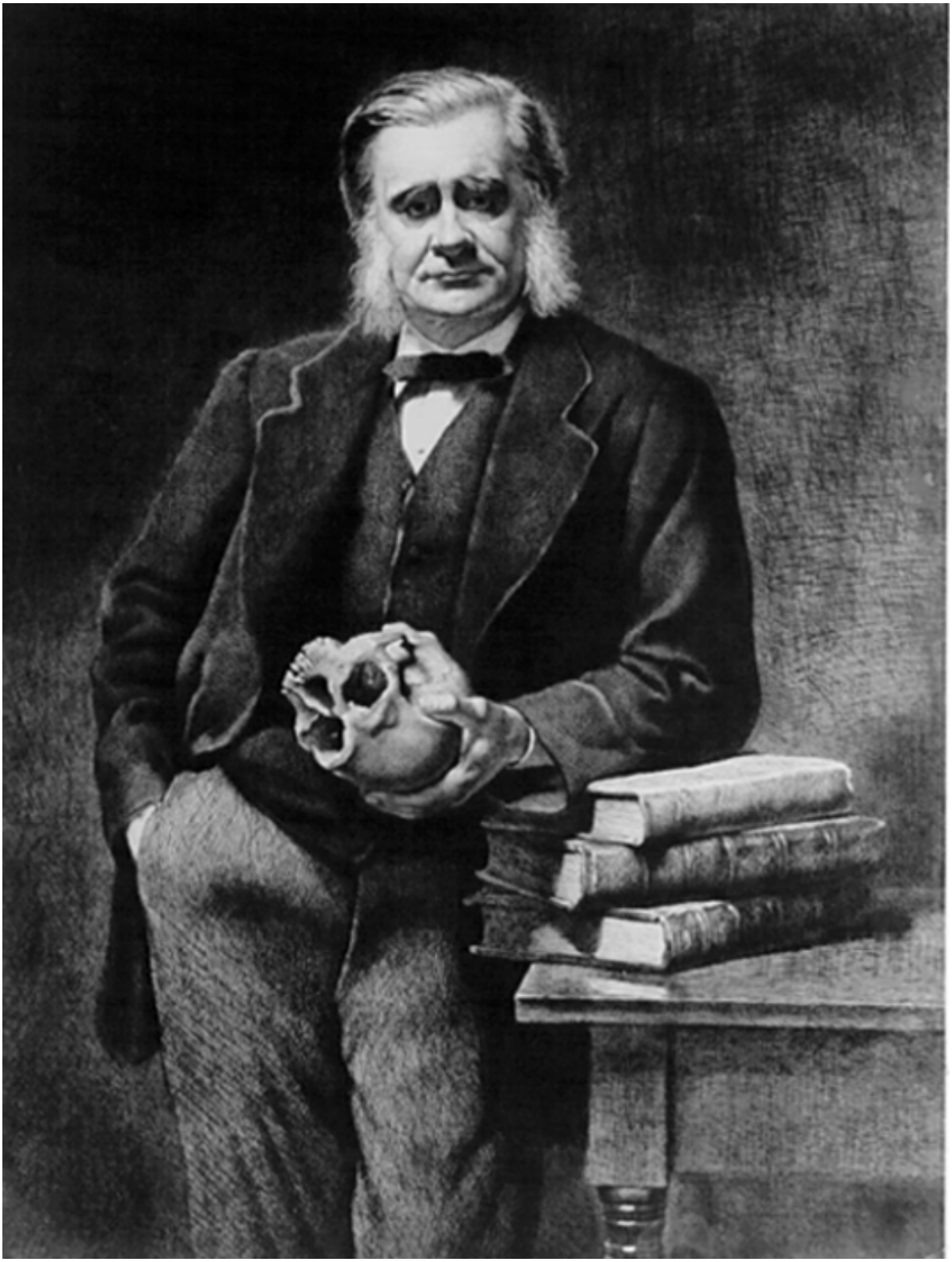

President, Royal Society

1883 Portrait by John Collier

Appleton ed., Vol VIII frontispiece

Preface VIII

(1894)

Discourses: Biological & Geological

Hodeslea, Eastbourne
April, 1894

[v] The contents of the present volume, with three exceptions, are either popular lectures, or addresses delivered to scientific bodies with which I have been officially connected. I am not sure which gave me the more trouble. For I have not been one of those fortunate persons who are able to regard a popular lecture as a mere *hors d'œuvre,* unworthy of being ranked among the serious efforts of a philosopher; and who keep their fame as scientific hierophants unsullied by attempts–at least of the successful sort–to be understanded of the people.

On the contrary, I found that the task of putting the truths learned in the field, the laboratory and the museum, into language which, without bating a jot of scientific accuracy shall be generally intelligible, taxed such scientific and literary faculty as I possessed to the uttermost; indeed my experience has furnished me with no better corrective of the tendency to scholastic pedantry which besets all those who are absorbed [vi] in pursuits remote from the common ways of men, and become habituated to think and speak in the technical dialect of their own little world, as if there were no other.

If the popular lecture thus, as I believe, finds one moiety of its justification in the self-discipline of the lecturer, it surely finds the other half in its effect on the auditory. For though various sadly comical experiences of the results of my own efforts have led me to entertain a very moderate estimate of the purely intellectual value of lectures; though I venture to doubt if more than one in ten of an average audience carries away an accurate notion of what the speaker has been driving at; yet is that not equally true of the oratory of the hustings, of the House of Commons, and even of the pulpit?

Yet the children of this world are wise in their generation; and both the politician and the priest are justified by results. The living voice has an influence over human action altogether independent of the intellectual worth of that which it utters. Many years ago, I was a guest at a great City dinner. A famous orator, endowed with a voice of rare flexibility and power; a born actor, ranging with ease through every part, from refined comedy to tragic unction, was called upon to reply to a toast. The orator was a very busy man, a charming conversationalist and by no means despised a good dinner; and, I imagine, rose with[vii]out having given a thought to what he was going to say. The rhythmic roll of sound was admirable, the gestures perfect, the earnestness impressive; nothing was lacking save sense and, occasionally grammar. When the speaker sat down the applause was terrific and one of my neighbours was especially enthusiastic. So when he had quieted down, I asked him what the orator had said. And he

could not tell me.

That sagacious person, John Wesley, is reported to have replied to some one who questioned the propriety of his adaptation of sacred words to extremely secular airs, that he did not see why the Devil should be left in possession of all the best tunes. And I do not see why science should not turn to account the peculiarities of human nature thus exploited by other agencies: all the more because science, by the nature of its being, cannot desire to stir the passions, or profit by the weaknesses, of human nature. The most zealous of popular lecturers can aim at nothing more than the awakening of a sympathy for abstract truth, in those who do not really follow his arguments; and of a desire to know more and better in the few who do.

At the same time it must be admitted that the popularization of science, whether by lecture or essay, has its drawbacks. Success in this department has its perils for those who succeed. The "people who fail" take their revenge, as we have [viii] recently had occasion to observe, by ignoring all the rest of a man's work and glibly labelling him a mere popularizer. If the falsehood were not too glaring, they would say the same of Faraday and Helmholtz and Kelvin.

On the other hand, of the affliction caused by persons who think that what they have picked up from popular exposition qualifies them for discussing the great problems of science, it may be said, as the Radical toast said of the power of the Crown in bygone days, that it "has increased, is increasing, and ought to be diminished." The oddities of "English as she is spoke" might be abundantly paralleled by those of "Science as she is misunderstood" in the sermon, the novel, and the leading article; and a collection of the grotesque travesties of scientific conceptions, in the shape of essays on such trifles as "the Nature of Life" and the "Origin of All Things," which reach me, from time to time, might well be bound up with them.

The tenth essay in this volume unfortunately brought me, I will not say into collision, but into a position of critical remonstrance with regard to some charges of physical heterodoxy, brought by my distinguished friend Lord Kelvin, against British Geology. As President of the Geological Society of London at that time (1869), I thought I might venture to plead that we were not such heretics as we seemed to be; and that, even if [ix] we were, recantation would not affect the question of evolution.

I am glad to see that Lord Kelvin has just reprinted his reply to my plea,[1] and I refer the reader to it. I shall not presume to question anything, that on such ripe consideration, Lord Kelvin has to say upon the physical problems involved. But I may remark that no one can have asserted more strongly than I have done, the necessity of looking to physics and mathematics, for help in regard to the earliest history of the globe. (See pp. 108 and 109 of this volume.)

And I take the opportunity of repeating the opinion, that, whether what we call geological time has the lower limit assigned to it by Lord Kelvin, or the higher assumed by other philosophers; whether the germs of all living things have originated in the globe itself, or whether they have been imported on, or in, meteorites from without, the problem of the origin of those successive Faunæ and Floræ of the earth,

the existence of which is fully demonstrated by palæontology remains exactly where it was.

For I think it will be admitted, that the germs brought to us by meteorites, if any, were not ova of elephants, nor of crocodiles; nor cocoa-nuts nor acorns; not even eggs of shell-fish and corals; but only those of the lowest forms of animal and vegetable life. Therefore since it is proved that, [x] from a very remote epoch of geological time, the earth has been peopled by a continual succession of the higher forms of animals and plants, these either must have been created, or they have arisen by evolution. And in respect of certain groups of animals, the well-established facts of palæontology leave no rational doubt that they arose by the latter method.

In the second place, there are no data whatever, which justify the biologist in assigning any, even approximately definite, period of time, either long or short, to the evolution of one species from another by the process of variation and selection. In the ninth of the following essays, I have taken pains to prove that the change of animals has gone on at very different rates in different groups of living beings; that some types have persisted with little change from the palæozoic epoch till now, while others have changed rapidly within the limits of an epoch. In 1862 (see below p. 303, 304) in 1863 (vol. II., p. 461) and again in 1864 (*ibid.*, p. 89–91) I argued, not as a matter of speculation, but, from palæontological facts, the bearing of which I believe, up to that time, had not been shown, that any adequate hypothesis of the causes of evolution must be consistent with progression, stationariness and retrogression, of the same type at different epochs; of different types in the same epoch; and that Darwin's hypothesis fulfilled these conditions.

[xi] According to that hypothesis, two factors are at work, variation and selection. Next to nothing is known of the causes of the former process; nothing whatever of the time required for the production of a certain amount of deviation from the existing type. And, as respects selection, which operates by extinguishing all but a small minority of variations, we have not the slightest means of estimating the rapidity with which it does its work. All that we are justified in saying is that the rate at which it takes place may vary almost indefinitely. If the famous paint-root of Florida, which kills white pigs but not black ones, were abundant and certain in its action, black pigs might be substituted for white in the course of two or three years. If, on the other hand, it was rare and uncertain in action, the white pigs might linger on for centuries.

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1 *Popular Lectures and Addresses.* II. Macmillan and Co., 1894.

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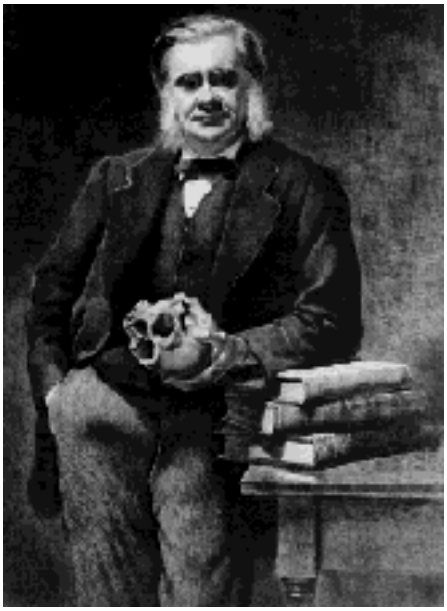

C. Blinderman & D. Joyce
Clark University

Hodeslea House

Appleton ed. Vol. IX frontispiece

Preface IX

(1894)

Evolution & Ethics and Other Essays

Hodeslea, Eastbourne
July, 1894

[v] The discourse on "Evolution and Ethics," reprinted in the first half of the present volume, was delivered before the University of Oxford, as the second of the annual lectures founded by Mr. Romanes: whose name I may not write without deploring the untimely death, in the flower of his age, of a friend endeared to me, as to so many others, by his kindly nature; and justly valued by all his colleagues for his powers of investigation and his zeal for the advancement of knowledge. I well remember, when Mr. Romanes' early work came into my hands, as one of the secretaries of the Royal

Society, how much I rejoiced in the accession to the ranks of the little army of workers in science of a recruit so well qualified to take a high place among us.

It was at my friend's urgent request that I agreed to undertake the lecture, should I be honoured with an official proposal to give it, though I confess not without misgivings, if only on [vi] account of the serious fatigue and hoarseness which public speaking has for some years caused me; while I knew that it would be my fate to follow the most accomplished and facile orator of our time, whose indomitable youth is in no matter more manifest than in his penetrating and musical voice. A certain saying about comparisons intruded itself somewhat importunately.

And even if I disregarded the weakness of my body in the matter of voice, and that of my mind in the matter of vanity, there remained a third difficulty. For several reasons, my attention, during a number of years, has been much directed to the bearing of modern scientific thought on the problems of morals and of politics, and I did not care to be diverted from that topic. Moreover, I thought it the most important and the worthiest which, at the present time, could engage the attention even of an ancient and renowned University.

But it is a condition of the Romanes foundation that the lecturer shall abstain from treating of either Religion or Politics; and it appeared to me that, more than most, perhaps, I was bound to act, not merely up to the letter, but in the spirit, of that prohibition. Yet Ethical Science is, on all sides, so entangled with Religion and Politics, that the lecturer who essays to touch the former without coming into contact with either of the latter, needs all the dexterity of an egg-dancer; and may even discover that his sense of clearness [vii] and his sense of propriety come into conflict, by no means to the advantage of the former.

I had little notion of the real magnitude of these difficulties when I set about my task; but I am consoled for my pains and anxiety by observing that none of the multitudinous criticisms with which I have been favoured and, often, instructed, find fault with me on the score of having strayed out of bounds.

Among my critics there are not a few to whom I feel deeply indebted for the careful attention which they have given to the exposition thus hampered; and further weakened, I am afraid, by my forgetfulness of a maxim touching lectures of a popular character, which has descended to me from that prince of lecturers, Mr. Faraday. He was once asked by a beginner, called upon to address a highly select and cultivated audience, what he might suppose his hearers to know already. Whereupon the past master of the art of exposition emphatically replied "Nothing!"

To my shame as a retired veteran, who has all his life profited by this great precept of lecturing strategy, I forgot all about it just when it would have been most useful. I was fatuous enough to imagine that a number of propositions, which I thought established, and which, in fact, I had advanced without challenge on former occasions, needed no repetition.

I have endeavoured to repair my error by [viii] prefacing the lecture with some matter–chiefly elementary or recapitulatory–to which I have given the title of "Prolegomena." I wish I could have hit

upon a heading of less pedantic aspect which would have served my purpose; and if it be urged that the new building looks over large for the edifice to which it is added, I can only plead the precedent of the ancient architects, who always made the adytum the smallest part of the temple.

If I had attempted to reply in full to the criticisms to which I have referred, I know not what extent of ground would have been covered by my *pronaos.* All I have endeavoured to do, at present, is to remove that which seems to have proved a stumbling-block to many–namely, the apparent paradox that ethical nature, while born of cosmic nature, is necessarily at enmity with its parent. Unless the arguments set forth in the Prolegomena, in the simplest language at my command, have some flaw which I am unable to discern, this seeming paradox is a truth, as great as it is plain, the recognition of which is fundamental for the ethical philosopher.

We cannot do without our inheritance from the forefathers who were the puppets of the cosmic process; the society which renounces it must be destroyed from without. Still less can we do with too much of it; the society in which it dominates must be destroyed from within.

[ix] The motive of the drama of human life is the necessity, laid upon every man who comes into the world, of discovering the mean between self-assertion and self-restraint suited to his character and his circumstances. And the eternally tragic aspect of the drama lies in this: that the problem set before us is one the elements of which can be but imperfectly known, and of which even an approximately right solution rarely presents itself, until that stern critic, aged experience, has been furnished with ample justification for venting his sarcastic humour upon the irreparable blunders we have already made.

I have reprinted the letters on the "Darkest England" scheme, published in the "Times" of December 1890 and January 1891; and subsequently issued, with additions, as a pamphlet, under the title of "Social Diseases and Worse Remedies;" because, although the clever attempt to rush the country on behalf of that scheme has been balked, Mr. Booth's standing army remains afoot, retaining all the capacities for mischief which are inherent in its constitution. I am desirous that this fact should be kept steadily in view; and that the moderation of the clamour of the drums and trumpets should not lead us to forget the existence of a force, which, in bad hands, may, at any time, be used for bad purposes.

In 1892, a Committee was "formed for the pur[x]pose of investigating the manner in which the moneys, subscribed in response to the appeal made in the book entitled 'In Darkest England and the Way out,' have been expended." The members of this body were gentlemen in whose competency and equity every one must have complete confidence; and in December 1892 they published a report in which they declare that, "with the exception of the sums expended on the 'barracks' at Hadleigh," the moneys in question have been "devoted only to the objects and expended in the methods set out in that appeal, and to and in no others."

Nevertheless, their final conclusion runs as follows: "(4) That whilst the invested property, real and personal, resulting from such Appeal is so vested and controlled by the Trust of the Deed of January 30th, 1891, that any application of it to purposes other than those declared in the deed by any 'General'

of the Salvation Army would amount to a breach of trust, and would subject him to the proceedings of a civil and criminal character, before mentioned in the Report, *adequate legal safeguards do not at present exist to prevent the misapplication of such property* ."

The passage I have italicised forms part of a document dated December l9th, 1892. It follows, that, even after the Deed of January 30th, 1891, was executed, "adequate legal safeguards" "to prevent the misapplication of the property" did [xi] not exist. What then was the state of things, up to a week earlier, that is on January 22nd, 1891, when my twelfth and last letter appeared in the "Times"? A better justification for what I have said about the want of adequate security for the proper administration of the funds intrusted to Mr. Booth could not be desired, unless it be that which is to be found in the following passages of the Report (pp. 36 and 37):–

"It is possible that a 'General' may be forgetful of his duty, and sell property and appropriate the proceeds to his own use, or to meeting the general liabilities of the Salvation Army. As matters now stand, he, and he alone, would have control over such a sale. Against such possibilities it appears to the Committee to be reasonable that some check should be imposed."

Once more let it be remembered that this opinion, given under the hand of Sir Henry James, was expressed by the Committee, with the Trust Deed of 1891, which has been so sedulously flaunted before the public, in full view.

The Committee made a suggestion for the improvement of this very unsatisfactory state of things; but the exact value set upon it by the suggestors should be carefully considered (p.37).

"The Committee are fully aware that if the views thus expressed are carried out, the safeguards and checks created will not be sufficient for all purposes absolutely to prevent possible [xii] dealing with the property and moneys, inconsistent with the purposes to which they are intended to be devoted."

In fact, they are content to express the very modest hope that "if the suggestion made be acted upon, some hindrance will thereby be placed in the way of any one acting dishonestly in respect of the disposal of the property and moneys referred to."

I do not know, and, under the circumstances, I cannot say I much care, whether the suggestions of the Committee have, or have not, been acted upon, Whether or not, the fact remains, that an unscrupulous "General" will have a pretty free hand, notwithstanding "some" hindrance.

Thus, the judgment of the highly authoritative, and certainly not hostile, Committee of 1892, upon the issues with which they concerned themselves is hardly such as to inspire enthusiastic confidence. And it is further to be borne in mind that they carefully excluded from their duties "any examination of the principles, government, teaching, or methods of the Salvation Army as a religious organisation, or of its affairs" except so far as they related to the administration of the moneys collected by the "Darkest England" appeal.

Consequently, the most important questions discussed in my letters were not in any way touched by the Committee. Even if their report [xiii] had been far more favourable to the "Darkest England" scheme than it is; if it had really assured the contributors that the funds raised were fully secured against malversation; the objections, on social and political grounds, to Mr. Booth's despotic organization, with its thousands of docile satellites pledged to blind obedience, set forth in the letters, would be in no degree weakened. The "sixpennyworth of good" would still be outweighed by the "shilling'sworth of harm"; if indeed the relative worth, or unworth, of the latter should not be rated in pounds rather than in shillings.

What would one not give for the opinion of the financial members of the Committee about the famous Bank; and that of the legal experts about the proposed "tribunes of the people"?

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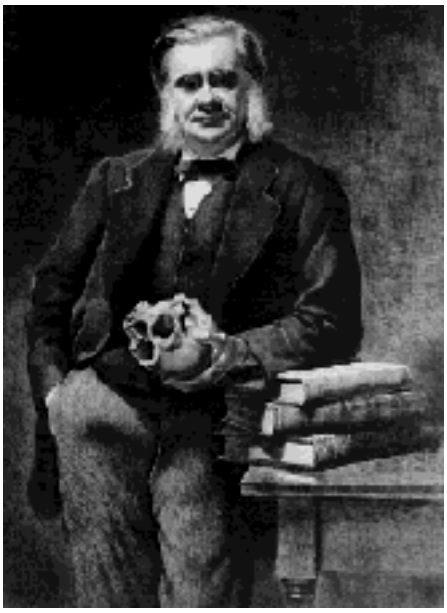

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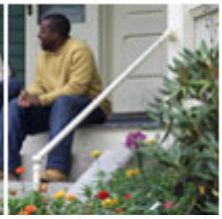

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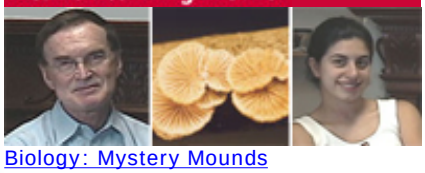

Biology: Mystery Mounds

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The Darwinian Hypothesis (1859)

Collected Essays II

[1] The hypothesis of which the present work of Mr. Darwin is but the preliminary outline, may be stated in his own language as follows:–"Species originated by means of natural selection, or through the preservation of the favoured races in the struggle for life." To render this thesis intelligible, it is necessary to interpret its terms. In the first place, what is a species? The question is a simple one, but the right answer to it is hard to find, even if we appeal to those who should know most about it. It is all those animals or plants which have descended from a single pair of parents; it is the smallest distinctly definable group of living organisms; it is an eternal and immutable entity; it is a mere abstraction of the human intellect having no existence in nature. Such are a few of the significations attached to [2] this simple word which may be culled from authoritative sources; and if, leaving terms and theoretical subtleties aside, we turn to facts and endeavour to gather a meaning for ourselves, by studying the things to which, in practice, the name of species is applied, it profits us little. For practice varies as much as theory. Let two botanists or two zoologists examine and describe the productions of a country, and one will pretty certainly disagree with the other as to the number, limits, and definitions of the species into which he groups the very same things. In these islands, we are in the habit of regarding mankind as of one species, but a fortnight's steam will land us in a country where divines and savants, for once in agreement, vie with one another in loudness of assertion, if not in cogency of proof, that men are of different species; and, more particularly, that the species negro is so distinct from our own that the Ten Commandments have actually no reference to him. Even in the calm region of entomology, where, if anywhere in this sinful world, passion and prejudice should fail to stir the mind, one learned coleopterist will fill ten attractive volumes with descriptions of species of beetles, nine-tenths of which are immediately declared by his brother beetle-mongers to be no species at all.

The truth is that the number of distinguishable living creatures almost surpasses imagination. At least 100,000 such kinds of insects alone have been [3] described and may be identified in collections, and the number of separable kinds of living things is under-estimated at half a million. Seeing that most of these obvious kinds have their accidental varieties, and that they often shade into others by imperceptible degrees, it may well be imagined that the task of distinguishing between what is permanent and what fleeting, what is a species and what a mere variety, is sufficiently formidable.

But is it not possible to apply a test whereby a true species may be known from a mere variety? Is there no criterion of species? Great authorities affirm that there is–that the unions of members of the same species are always fertile, while those of distinct species are either sterile, or their offspring, called hybrids, are so. It is affirmed not only that this is an experimental fact, but that it is a provision for the preservation of the purity of species. Such a criterion as this would be invaluable; but, unfortunately, not only is it not obvious how to apply it in the great majority of cases in which its aid is needed, but its general validity is stoutly denied. The Hon. and Rev. Mr. Herbert, a most trustworthy authority, not only asserts as the result of his own observations and experiments that many hybrids are quite as fertile as the

parent species, but he goes so far as to assert that the particular plant *Crinum capense* is much more fertile when crossed by a [4] distinct species than when fertilised by its proper pollen! On the other hand, the famous Gaertner, though he took the greatest pains to cross the Primrose and the Cowslip, succeeded only once or twice in several years; and yet it is a well-established fact that the Primrose and the Cowslip are only varieties of the same kind of plant. Again, such cases as the following are well established. The female of species A, if crossed with the male of species B, is fertile; but, if the female of B is crossed with the male of A, she remains barren. Facts of this kind destroy the value of the supposed criterion.

If, weary of the endless difficulties involved in the determination of species, the investigator, contenting himself with the rough practical distinction of separable kinds, endeavours to study them as they occur in nature–to ascertain their relations to the conditions which surround them, their mutual harmonies and discordancies of structure, the bond of union of their present and their past history, he finds himself, according to the received notions, in a mighty maze, and with, at most, the dimmest adumbration of a plan. If he starts with any one clear conviction, it is that every part of a living creature is cunningly adapted to some special use in its life. Has not his Paley told him that that seemingly useless organ, the spleen, is beautifully adjusted as so much packing between the other organs? And [5] yet, at the outset of his studies, he finds that no adaptive reason whatsoever can be given for one-half of the peculiarities of vegetable structure. He also discovers rudimentary teeth, which are never used, in the gums of the young calf and in those of the fœtal whale; insects which never bite have rudimental jaws, and others which never fly have rudimental wings; naturally blind creatures have rudimental eyes; and the halt have rudimentary limbs. So, again, no animal or plant puts on its perfect form at once, but all have to start from the same point, however various the course which each has to pursue. Not only men and horses, and cats and dogs, lobsters and beetles, periwinkles and mussels, but even the very sponges and animalcules commence their existence under forms which are essentially undistinguishable; and this is true of all the infinite variety of plants. Nay, more, all living beings march, side by side, along the high road of development, and separate the later the more like they are; like people leaving church, who all go down the aisle, but having reached the door, some turn into the parsonage, others go down the village, and others part only in the next parish. A man in his development runs for a little while parallel with, though never passing through, the form of the meanest worm, then travels for a space beside the fish, then journeys along with the bird and the reptile for his fellow travellers; [6] and only at last, after a brief companionship with the highest of the four-footed and four-handed world, rises into the dignity of pure manhood. No competent thinker of the present day dreams of explaining these indubitable facts by the notion of the existence of unknown and undiscoverable adaptations to purpose. And we would remind those who, ignorant of the facts, must be moved by authority, that no one has asserted the incompetence of the doctrine of final causes, in its application to physiology and anatomy, more strongly than our own eminent anatomist, Professor Owen, who, speaking of such cases, says ("On the Nature of Limbs," pp. 39, 40)–"I think it will be obvious that the principle of final adaptations fails to satisfy all the conditions of the problem."

But, if the doctrine of final causes will not help us to comprehend the anomalies of living structure, the principle of adaptation must surely lead us to understand why certain living beings are found in certain regions of the world and not in others. The Palm, as we know, will not grow in our climate, nor the Oak

in Greenland. The white bear cannot live where the tiger thrives, nor *vice versa,* and the more the natural habits of animal and vegetable species are examined, the more do they seem, on the whole, limited to particular provinces. But when we look into the facts established by the study of the geographical [7] distribution of animals and plants it seems utterly hopeless to attempt to understand the strange and apparently capricious relations which they exhibit. One would be inclined to suppose *a priori* that every country must be naturally peopled by those animals that are fittest to live and thrive in it. And yet how, on this hypothesis, are we to account for the absence of cattle in the Pampas of South America, when those parts of the New World were discovered? It is not that they were unfit for cattle, for millions of cattle now run wild there; and the like holds good of Australia and New Zealand. It is a curious circumstance, in fact, that the animals and plants of the Northern Hemisphere are not only as well adapted to live in the Southern Hemisphere as its own autochthones, but are, in many cases, absolutely better adapted, and so overrun and extirpate the aborigines. Clearly, therefore, the species which naturally inhabit a country are not necessarily the best adapted to its climate and other conditions. The inhabitants of islands are often distinct from any other known species of animal or plants (witness our recent examples from the work of Sir Emerson Tennent, on Ceylon), and yet they have almost always a sort of general family resemblance to the animals and plants of the nearest mainland. On the other hand, there is hardly a species of fish, shell, or crab common to the opposite sides of the narrow [8] isthmus of Panama.[1] Wherever we look, then, living nature offers us riddles of difficult solution, if we suppose that what we see is all that can be known of it.

But our knowledge of life is not confined to the existing world. Whatever their minor differences, geologists are agreed as to the vast thickness of the accumulated strata which compose the visible part of our earth, and the inconceivable immensity of the time the lapse of which they are the imperfect but the only accessible witnesses. Now, throughout the greater part of this long series of stratified rocks are scattered, sometimes very abundantly, multitudes of organic remains, the fossilised exuviæ of animals and plants which lived and died while the mud of which the rocks are formed was yet soft ooze, and could receive and bury them. It would be a great error to suppose that these organic remains were fragmentary relics. Our museums exhibit fossil shells of immeasurable antiquity, as perfect as the day they were formed; whole skeletons without a limb disturbed; nay, the changed flesh, the developing embryos, and even the very footsteps of primieval organisms. Thus the naturalist finds in the bowels of the earth species as well defined as, and in some groups of animals more numerous than, those which breathe the upper air. But, singularly enough, the majority of these entombed species are wholly [9] distinct from those that now live. Nor is this unlikeness without its rule and order. As a broad fact, the further we go back in time the less the buried species are like existing forms; and, the further apart the sets of extinct creatures are, the less they are like one another. In other words, there has been a regular succession of living beings, each younger set, being in a very broad and general sense, somewhat more like those which now live.

It was once supposed that this succession had been the result of vast successive catastrophes, destructions, and re-creations *en masse;* but catastrophes are now almost eliminated from geological, or at least palæontological speculation; and it is admitted, on all hands, that the seeming breaks in the chain of being are not absolute, but only relative to our imperfect knowledge; that species have replaced species, not in assemblages, but one by one; and that, if it were possible to have all the phenomena of the

past presented to us, the convenient epochs and formations of the geologist, though having a certain distinctness, would fade into one another with limits as undefinable as those of the distinct and yet separable colours of the solar spectrum.

Such is a brief summary of the main truths which have been established concerning species. Are these truths ultimate and irresolvable facts, or are their complexities and perplexities the mere expressions of a higher law?

[10] A large number of persons practically assume the former position to be correct. They believe that the writer of the Pentateuch was empowered and commissioned to teach us scientific as well as other truth, that the account we find there of the creation of living things is simply and literally correct, and that anything which seems to contradict it is, by the nature of the case, false. All the phenomena which have been detailed are, on this view, the immediate product of a creative fiat and, consequently, are out of the domain of science altogether.

Whether this view prove ultimately to be true or false, it is, at any rate, not at present supported by what is commonly regarded as logical proof, even if it be capable of discussion by reason; and hence we consider ourselves at liberty to pass it by, and to turn to those views which profess to rest on a scientific basis only, and therefore admit of being argued to their consequences. And we do this with the less hesitation as it so happens that those persons who are practically conversant with the facts of the case (plainly a considerable advantage) have always thought fit to range themselves under the latter category.

The majority of these competent persons have up to the present time maintained two positions–the first, that every species is, within certain defined limits, fixed and incapable of modification; the second, that every species was originally pro[11]duced by a distinct creative act. The second position is obviously incapable of proof or disproof, the direct operations of the Creator not being subjects of science; and it must therefore be regarded as a corollary from the first, the truth or falsehood of which is a matter of evidence. Most persons imagine that the arguments in favour of it are overwhelming; but to some few minds, and these, it must be confessed, intellects of no small power and grasp of knowledge, they have not brought conviction. Among these minds, that of the famous naturalist Lamarck, who possessed a greater acquaintance with the lower forms of life than any man of his day, Cuvier not excepted, and was a good botanist to boot, occupies a prominent place.

Two facts appear to have strongly affected the course of thought of this remarkable man–the one, that finer or stronger links of affinity connect all living beings with one another, and that thus the highest creature grades by multitudinous steps into the lowest; the other, that an organ may be developed in particular directions by exerting itself in particular ways, and that modifications once induced may be transmitted and become hereditary. Putting these facts together, Lamarck endeavoured to account for the first by the operation of the second. Place an animal in new circumstances, says he, and its needs will be altered; the new needs will create new desires, and [12] the attempt to gratify such desires will result in an appropriate modification of the organs exerted. Make a man a blacksmith, and his brachial muscles will develop in accordance with the demands made upon them, and in like manner, says Lamarck, "the

efforts of some short-necked bird to catch fish without wetting himself have, with time and perseverance, given rise to all our herons and long-necked waders."

The Lamarckian hypothesis has long since been justly condemned, and it is the established practice for every tyro to raise his heel against the carcass of the dead lion. But it is rarely either wise or instructive to treat even the errors of a really great man with mere ridicule, and in the present case the logical form of the doctrine stands on a very different footing from its substance.

If species have really arisen by the operation of natural conditions, we ought to be able to find those conditions now at work; we ought to be able to discover in nature some power adequate to modify any given kind of animal or plant in such a manner as to give rise to another kind, which would be admitted by naturalists as a distinct species. Lamarck imagined that he had discovered this *vera causa* in the admitted facts that some organs may be modified by exercise; and that modifications, once produced, are capable of hereditary transmission. It does not seem to have occurred to him to inquire whether there is [13] any reason to believe that there are any limits to the amount of modification producible, or to ask how long an animal is likely to endeavour to gratify an impossible desire. The bird, in our example, would surely have renounced fish dinners long before it had produced the least effect on leg or neck.

Since Lamarck's time, almost all competent naturalists have left speculations on the origin of species to such dreamers as the author of the "Vestiges," by whose well-intentioned efforts the Lamarckian theory received its final condemnation in the minds of all sound thinkers. Notwithstanding this silence, however, the transmutation theory, as it has been called, has been a "skeleton in the closet" to many an honest zoologist and botanist who had a soul above the mere naming of dried plants and skins. Surely, has such an one thought, nature is a mighty and consistent whole, and the providential order established in the world of life must, if we could only see it rightly, be consistent with that dominant over the multiform shapes of brute matter. But what is the history of astronomy, of all the branches of physics, of chemistry, of medicine, but a narration of the steps by which the human mind has been compelled, often sorely against its will, to recognise the operation of secondary causes in events where ignorance beheld an immediate intervention of a higher power? And when we know that living [14] things are formed of the same elements as the inorganic world, that they act and react upon it, bound by a thousand ties of natural piety, is it probable, nay is it possible, that they, and they alone, should have no order in their seeming disorder, no unity in their seeming multiplicity, should suffer no explanation by the discovery of some central and sublime law of mutual connection?

Questions of this kind have assuredly often arisen, but it might have been long before they received such expression as would have commanded the respect and attention of the scientific world, had it not been for the publication of the work which prompted this article. Its author, Mr. Darwin, inheritor of a once celebrated name, won his spurs in science when most of those now distinguished were young men, and has for the last twenty years held a place in the front ranks of British philosophers. After a circumnavigatory voyage, undertaken solely for the love of his science, Mr. Darwin published a series of researches which at once arrested the attention of naturalists and geologists; his generalisations have since received ample confirmation and now command universal assent, nor is it questionable that they have had the most important influence on the progress of science. More recently Mr. Darwin, with a

versatility which is among the rarest of gifts, turned his attention to a most difficult question of [15] zoology and minute anatomy; and no living naturalist and anatomist has published a better monograph than that which resulted from his labours. Such a man, at all events, has not entered the sanctuary with unwashed hands, and when he lays before us the results of twenty years' investigation and reflection we must listen even though we be disposed to strike. But, in reading his work, it must be confessed that the attention which might at first be dutifully, soon becomes willingly, given, so clear is the author's thought, so outspoken his conviction, so honest and fair the candid expression of his doubts. Those who would judge the book must read it: we shall endeavour only to make its line of argument and its philosophical position intelligible to the general reader in our own way.

The Baker Street Bazaar has just been exhibiting its familiar annual spectacle. Straight-backed, small-headed, big-barrelled oxen, as dissimilar from any wild species as can well be imagined, contended for attention and praise with sheep of half-a-dozen different breeds and styes of bloated preposterous pigs, no more like a wild boar or sow than a city alderman is like an ourang-outang. The cattle show has been, and perhaps may again be, succeeded by a poultry show, of whose crowing and clucking prodigies it can only be certainly predicated that they will be very unlike the aboriginal *Phasianus gallus.* If the seeker after [16] animal anomalies is not satisfied, a turn or two in Seven Dials will convince him that the breeds of pigeons are quite as extraordinary and unlike one another and their parent stock, while the Horticultural Society will provide him with any number of corresponding vegetable aberrations from nature's types. He will learn with no little surprise, too, in the course of his travels, that the proprietors and producers of these animal and vegetable anomalies regard them as distinct species, with a firm belief, the strength of which is exactly proportioned to their ignorance of scientific biology, and which is the more remarkable as they are all proud of their skill in originating such "species."

On careful inquiry it is found that all these, and the many other artificial breeds or races of animals and plants, have been produced by one method. The breeder–and a skilful one must be a person of much sagacity and natural or acquired perceptive faculty–notes some slight difference, arising he knows not how, in some individuals of his stock. If he wish to perpetuate the difference, to form a breed with the peculiarity in question strongly marked, he selects such male and female individuals as exhibit the desired character, and breeds from them. Their offspring are then carefully examined, and those which exhibit the peculiarity the most distinctly are selected for breeding; and this operation is repeated until the desired amount [17] of divergence from the primitive stock is reached. It is then found that by continuing the process of selection–always breeding, that is, from well-marked forms, and allowing no impure crosses to interfere–a race may be formed, the tendency of which to reproduce itself is exceedingly strong; nor is the limit to the amount of divergence which may be thus produced known; but one thing is certain, that, if certain breeds of dogs, or of pigeons, or of horses, were known only in a fossil state, no naturalist would hesitate in regarding them as distinct species.

But in all these cases we have human interference. Without the breeder there would be no selection, and without the selection no race. Before admitting the possibility of natural species having originated in any similar way, it must be proved that there is in Nature some power which takes the place of man, and performs a selection *suâsponte.* It is the claim of Mr. Darwin that he professes to have discovered the existence and the *modus operandi* of this "natural selection," as he terms it; and, if he be right, the

process is perfectly simple and comprehensible, and irresistibly deducible from very familiar but well nigh forgotten facts.

Who, for instance, has duly reflected upon all the consequences of the marvellous struggle for existence which is daily and hourly going on among living beings? Not only does every animal [18] live at the expense of some other animal or plant, but the very plants are at war. The ground is full of seeds that cannot rise into seedlings; the seedlings rob one another of air, light and water, the strongest robber winning the day, and extinguishing his competitors. Year after year, the wild animals with which man never interferes are, on the average, neither more nor less numerous than they were; and yet we know that the annual produce of every pair is from one to perhaps a million young; so that it is mathematically certain that, on the average, as many are killed by natural causes as are born every year, and those only escape which happen to be a little better fitted to resist destruction than those which die. The individuals of a species are like the crew of a foundered ship, and none but good swimmers have a chance of reaching the land.

Such being unquestionably the necessary conditions under which living creatures exist, Mr. Darwin discovers in them the instrument of natural selection. Suppose that in the midst of this incessant competition some individuals of a species (A) present accidental variations which happen to fit them a little better than their fellows for the struggle in which they are engaged, then the chances are in favour, not only of these individuals being better nourished than the others, but of their predominating over their fellows in other ways, and of having a better chance of leaving [19] offspring, which will of course tend to reproduce the peculiarities of their parents. Their offspring will, by a parity of reasoning, tend to predominate over their contemporaries, and there being (suppose) no room for more than one species such as A, the weaker variety will eventually be destroyed by the new destructive influence which is thrown into the scale, and the stronger will take its place. Surrounding conditions remaining unchanged, the new variety (which we may call B)–supposed, for argument's sake, to be the best adapted for these conditions which can be got out of the original stock–will remain unchanged, all accidental deviations from the type becoming at once extinguished, as less fit for their post than B itself. The tendency of B to persist will grow with its persistence through successive generations, and it will acquire all the characters of a new species.

But, on the other hand, if the conditions of life change in any degree, however slight, B may no longer be that form which is best adapted to withstand their destructive, and profit by their sustaining, influence; in which case if it should give rise to a more competent variety (C), this will take its place and become a new species; and thus, by natural selection, the species B and C will be successively derived from A.

That this most ingenious hypothesis enables us to give a reason for many apparent anomalies in the distribution of living beings in time and space, [20] and that it is not contradicted by the main phenomena of life and organisation appear to us to be unquestionable; and, so far, it must be admitted to have an immense advantage over any of its predecessors. But it is quite another matter to affirm absolutely either the truth or falsehood of Mr. Darwin's views at the present stage of the inquiry. Goethe has an excellent aphorism defining that state of mind which he calls "Thätige Skepsis"–active doubt. It is

doubt which so loves truth that it neither dares rest in doubting, nor extinguish itself by unjustified belief; and we commend this state of mind to students of species, with respect to Mr. Darwin's or any other hypothesis, as to their origin. The combined investigations of another twenty years may, perhaps, enable naturalists to say whether the modifying causes and the selective power, which Mr. Darwin has satisfactorily shown to exist in Nature, are competent to produce all the effects he ascribes to them; or whether, on the other hand, he has been led to over-estimate the value of the principle of natural selection, as greatly as Lamarck overestimated his *vera causa* of modification by exercise.

But there is, at all events, one advantage possessed by the more recent writer over his predecessor. Mr. Darwin abhors mere speculation as nature abhors a vacuum. He is as greedy of cases and precedents as any constitutional lawyer, and all the principles he lays down are capable of being [21] brought to the test of observation and experiment. The path he bids us follow professes to be, not a mere airy track, fabricated of ideal cobwebs, but a solid and broad bridge of facts. If it be so, it will carry us safely over many a chasm in our knowledge, and lead us to a region free from the snares of those fascinating but barren virgins, the Final Causes, against whom a high authority has so justly warned us. "My sons, dig in the vineyard," were the last words of the old man in the fable: and, though the sons found no treasure, they made their fortunes by the grapes.

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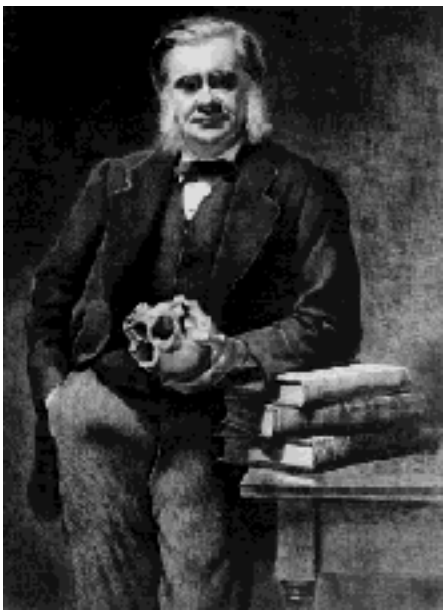
[1] Recent investigations tend to show that this statement is not strictly accurate–1870.



The Origin of Species (1860)

Collected Essays II

[22] Mr. Darwin's long-standing and well-earned scientific eminence probably renders him indifferent to that social notoriety which passes by the name of success; but if the calm spirit of the philosopher have not yet wholly superseded the ambition and the vanity of the carnal man within him, he must be well satisfied with the results of his venture in publishing the "Origin of Species." Overflowing the narrow bounds of purely scientific circles, the "species question" divides with Italy and the Volunteers the attention of general society. Everybody has read Mr. Darwin's book, or, at least, has given an opinion upon its merits or demerits; pietists, whether lay or ecclesiastic, decry it with the mild railing which sounds so charitable; bigots denounce it with ignorant invective; old ladies of both sexes consider it a [23] decidedly dangerous book, and even savants, who have no better mud to throw, quote antiquated writers to show that its author is no better than an ape himself; while every philosophical thinker hails it as a veritable Whitworth gun in the armoury of liberalism; and all competent naturalists and physiologists, whatever their opinions as to the ultimate fate of the doctrines put forth, acknowledge that the work in which they are embodied is a solid contribution to knowledge and inaugurates a new epoch in natural history.

Nor has the discussion of the subject been restrained within the limits of conversation. When the public is eager and interested, reviewers must minister to its wants; and the genuine *littérateur* is too much in the habit of acquiring his knowledge from the book he judges–as the Abyssinian is said to provide himself with steaks from the ox which carries him–to be withheld from criticism of a profound scientific work by the mere want of the requisite preliminary scientific acquirement; while, on the other hand, the men of science who wish well to the new views, no less than those who dispute their validity, have naturally sought opportunities of expressing their opinions. Hence it is not surprising that almost all the critical journals have noticed Mr. Darwin's work at greater or less length; and so many disquisitions, of every degree of excellence, from the poor product of ignorance, too often stimulated by [24] prejudice, to the fair and thoughtful essay of the candid student of Nature, have appeared, that it seems an almost hopeless task to attempt to say anything new upon the question.

But it may be doubted if the knowledge and acumen of prejudged scientific opponents, and the subtlety of orthodox special pleaders, have yet exerted their full force in mystifying the real issues of the great controversy which has been set afoot, and whose end is hardly likely to be seen by this generation; so that, at this eleventh hour, and even failing anything new, it may be useful to state afresh that which is true, and to put the fundamental positions advocated by Mr. Darwin in such a form that they may be grasped by those whose special studies lie in other directions. And the adoption of this course may be the more advisable, because, notwithstanding its great deserts, and indeed partly on account of them, the "Origin of Species" is by no means an easy book to read–if by reading is implied the full comprehension of an author's meaning.

We do not speak jestingly in saying that it is Mr. Darwin's misfortune to know more about the question he has taken up than any man living. Personally and practically exercised in zoology, in minute anatomy, in geology; a student of geographical distribution, not on maps and in museums only, but by long voyages and laborious collection; having largely advanced each of these branches of [25] science, and having spent many years in gathering and sifting materials for his present work, the store of accurately registered facts upon which the author of the "Origin of Species" is able to draw at will is prodigious.

But this very superabundance of matter must have been embarrassing to a writer who, for the present, can only put forward an abstract of his views; and thence it arises, perhaps, that notwithstanding the clearness of the style, those who attempt fairly to digest the book find much of it a sort of intellectual pemmican–a mass of facts crushed and pounded into shape, rather than held together by the ordinary medium of an obvious logical bond; due attention will, without doubt, discover this bond, but it is often hard to find.

Again, from sheer want of room, much has to be taken for granted which might readily enough be proved; and hence, while the adept, who can supply the missing links in the evidence from his own knowledge, discovers fresh proof of the singular thoroughness with which all difficulties have been considered and all unjustifiable suppositions avoided, at every reperusal of Mr. Darwin's pregnant paragraphs, the novice in biology is apt to complain of the frequency of what he fancies is gratuitous assumption.

Thus while it may be doubted if, for some years, any one is likely to be competent to pronounce judgment on all the issues raised by Mr. Darwin, [26] there is assuredly abundant room for him, who, assuming the humbler, though perhaps as useful, office of an interpreter between the "Origin of Species" and the public, contents himself with endeavouring to point out the nature of the problems which it discusses; to distinguish between the ascertained facts and the theoretical views which it contains; and finally, to show the extent to which the explanation it offers satisfies the requirements of scientific logic. At any rate, it is this office which we purpose to undertake in the following pages.

It may be safely assumed that our readers have a general conception of the nature of the objects to which the word "species" is applied; but it has, perhaps, occurred to a few, even to those who are naturalists *ex professo*, to reflect, that, as commonly employed, the term has a double sense and denotes two very different orders of relations. When we call a group of animals, or of plants, a species, we may imply thereby, either that all these animals or plants have some common peculiarity of form or structure; or, we may mean that they possess some common functional character. That part of biological science which deals with form and structure is called Morphology–that which concerns itself with function, Physiology–so that we may conveniently speak of these two senses, or aspects, of "species"–the one as morphological, the other as physiological. Regarded [27] from the former point of view, a species is nothing more than a kind of animal or plant, which is distinctly definable from all others, by certain constant, and not merely sexual, morphological peculiarities. Thus horses form a species, because the group of animals to which that name is applied is distinguished from all others in the world by the following constantly associated characters. They have–1, A vertebral column; 2, Mammæ; 3, A

placental embryo; 4, Four legs; 5, A single well-developed toe in each foot provided with a hoof; 6, A bushy tail; and 7, Callosities on the inner sides of both the fore and the hind legs. The asses, again, form a distinct species, because, with the same characters, as far as the fifth in the above list, all asses have tufted tails, and have callosities only on the inner side of the fore-legs. If animals were discovered having the general characters of the horse, but sometimes with callosities only on the fore-legs, and more or less tufted tails; or animals having the general characters of the ass, but with more or less bushy tails, and sometimes with callosities on both pairs of legs, besides being intermediate in other respects–the two species would have to be merged into one. They could no longer be regarded as morphologically distinct species, for they would not be distinctly definable one from the other.

However bare and simple this definition of species may appear to be, we confidently appeal to [28] all practical naturalists, whether zoologists, botanists, or palæontologists, to say if, in the vast majority of cases, they know, or mean to affirm anything more of the group of animals or plants they so denominate than what has just been stated. Even the most decided advocates of the received doctrines respecting species admit this.

"I apprehend," says Professor Owen,[1] "that few naturalists nowadays, in describing and proposing a name for what they call 'a new *species,*' use that term to signify what was meant by it twenty or thirty years ago; that is, an originally distinct creation, maintaining its primitive distinction by obstructive generative peculiarities. The proposer of the new species now intends to state no more than he actually knows; as, for example, that the differences on which he founds the specific character are constant in individuals of both sexes, so far as observation has reached; and that they are not due to domestication or to artificially superinduced external circumstances, or to any outward influence within his cognizance; that the species is wild, or is such as it appears by Nature."

If we consider, in fact, that by far the largest proportion of recorded existing species are known only by the study of their skins, or bones, or other lifeless exuviæ; that we are acquainted with none, or next to none, of their physiological peculiarities, beyond those which can be deduced from their structure, or are open to cursory observation; and that we cannot hope to learn more of any of those extinct forms of life which now constitute no inconsiderable proportion of the known Flora and [29] Fauna of the world: it is obvious that the definitions of these species can be only of a purely structural, or morphological, character. It is probable that naturalists would have avoided much confusion of ideas if they had more frequently borne the necessary limitations of our knowledge in mind. But while it may safely be admitted that we are acquainted with only the morphological characters of the vast majority of species–the functional or physiological, peculiarities of a few have been carefully investigated, and the result of that study forms a large and most interesting portion of the physiology of reproduction.

The student of Nature wonders the more and is astonished the less, the more conversant he becomes with her operations; but of all the perennial miracles she offers to his inspection, perhaps the most worthy of admiration is the development of a plant or of an animal from its embryo. Examine the recently laid egg of some common animal, such as a salamander or newt. It is a minute spheroid in which the best microscope will reveal nothing but a structureless sac, enclosing a glairy fluid, holding granules in suspension.[2] But strange possibilities lie dormant in that semi-fluid globule. Let a moderate

supply of warmth reach its watery cradle, and the plastic matter undergoes changes [29] so rapid, yet so steady and purpose-like in their succession, that one can only compare them to those operated by a skilled modeller upon a formless lump of clay. As with an invisible trowel, the mass is divided and subdivided into smaller and smaller portions, until it is reduced to an aggregation of granules not too large to build withal the finest fabrics of the nascent organism. And, then, it is as if a delicate finger traced out the line to be occupied by the spinal column, and moulded the contour of the body; pinching up the head at one end, the tail at the other, and fashioning flank and limb into due salamandrine proportions, in so artistic a way, that, after watching the process hour by hour, one is almost involuntarily possessed by the notion, that some more subtle aid to vision than an achromatic, would show the hidden artist, with his plan before him, striving with skilful manipulation to perfect his work.

As life advances, and the young amphibian ranges the waters, the terror of his insect contemporaries, not only are the nutritious particles supplied by its prey, by the addition of which to its frame, growth takes place, laid down, each in its proper spot, and in such due proportion to the rest, as to reproduce the form, the colour, and the size, characteristic of the parental stock; but even the wonderful powers of reproducing lost parts possessed by these animals are controlled by the same governing tendency. Cut off the legs, the [31] tail, the jaws, separately or all together, and, as Spallanzani showed long ago, these parts not only grow again, but the redintegrated limb is formed on the same type as those which were lost. The new jaw, or leg, is a newt's, and never by any accident more like that of a frog. What is true of the newt is true of every animal and of every plant; the acorn tends to build itself up again into a woodland giant such as that from whose twig it fell; the spore of the humblest lichen reproduces the green or brown incrustation which gave it birth; and at the other end of the scale of life, the child that resembled neither the paternal nor the maternal side of the house would be regarded as a kind of monster.

So that the one end to which, in all living beings, the formative impulse is tending–the one scheme which the Archæus of the old speculators strives to carry out, seems to be to mould the offspring into the likeness of the parent. It is the first great law of reproduction, that the offspring tends to resemble its parent or parents, more closely than anything else.

Science will some day show us how this law is a necessary consequence of the more general laws which govern matter; but, for the present, more can hardly be said than that it appears to be in harmony with them. We know that the phænomena of vitality are not something apart from other physical phænomena, but one with them; [32] and matter and force are the two names of the one artist who fashions the living as well as the lifeless. Hence living bodies should obey the same great laws as other matter–nor, throughout Nature, is there a law of wider application than this, that a body impelled by two forces takes the direction of their resultant. But living bodies may be regarded as nothing but extremely complex bundles of forces held in a mass of matter, as the complex forces of a magnet are held in the steel by its coercive force; and, since the differences of sex are comparatively slight, or, in other words, the sum of the forces in each has a very similar tendency, their resultant, the offspring, may reasonably be expected to deviate but little from a course parallel to either, or to both.

Represent the reason of the law to ourselves by what physical metaphor or analogy we will, however,

the great matter is to apprehend its existence and the importance of the consequences deducible from it. For things which are like to the same are like to one another; and if; in a great series of generations, every offspring is like its parent, it follows that all the offspring and all the parents must be like one another; and that, given an original parental stock, with the opportunity of undisturbed multiplication, the law in question necessitates the production, in course of time, of an indefinitely large group, the whole of the members of which are at once very similar and are blood [33] relations, having descended from the same parent, or pair of parents. The proof that all the members of any given group of animals, or plants, had thus descended, would be ordinarily considered sufficient to entitle them to the rank of physiological species, for most physiologists consider species to be definable as "the offspring of a single primitive stock."

But though it is quite true that all those groups we call species may, according to the known laws of reproduction, have descended from a single stock, and though it is very likely they really have done so, yet this conclusion rests on deduction and can hardly hope to establish itself upon a basis of observation. And the primitiveness of the supposed single stock, which, after all, is the essential part of the matter, is not only a hypothesis, but one which has not a shadow of foundation, if by "primitive" be meant "independent of any other living being." A scientific definition, of which an unwarrantable hypothesis forms an essential part, carries its condemnation within itself; but, even supposing such a definition were, in form, tenable, the physiologist who should attempt to apply it in Nature would soon find himself involved in great, if not inextricable, difficulties. As we have said, it is indubitable that offspring *tend* to resemble the parental organism, but it is equally true that the similarity attained never amounts to identity [34] either in form or in structure. There is always a certain amount of deviation, not only from the precise characters of a single parent, but when, as in most animals and many plants, the sexes are lodged in distinct individuals, from an exact mean between the two parents. And indeed, on general principles, this slight deviation seems as intelligible as the general similarity, if we reflect how complex the co-operating "bundles of forces" are, and how improbable it is that, in any case, their true resultant shall coincide with any mean between the more obvious characters of the two parents. Whatever be its cause, however, the co-existence of this tendency to minor variation with the tendency to general similarity, is of vast importance in its bearing on the question of the origin of species.

As a general rule, the extent to which an offspring differs from its parent is slight enough; but, occasionally, the amount of difference is much more strongly marked, and then the divergent offspring receives the name of a Variety. Multitudes, of what there is every reason to believe are such varieties, are known, but the origin of very few has been accurately recorded, and of these we will select two as more especially illustrative of the main features of variation. The first of them is that of the "Ancon" or "Otter" sheep, of which a careful account is given by Colonel David Humphreys, F.R.S., in a letter to Sir [35] Joseph Banks, published in the "Philosophical Transactions" for 1813. It appears that one Seth Wright, the proprietor of a farm on the banks of the Charles River, in Massachusetts, possessed a flock of fifteen ewes and a ram of the ordinary kind. In the year 1791, one of the ewes presented her owner with a male lamb, differing, for no assignable reason, from its parents by a proportionally long body and short bandy legs, whence it was unable to emulate its relatives in those sportive leaps over the neighbours' fences, in which they were in the habit of indulging, much to the good farmer's vexation.

The second case is that detailed by a no less unexceptionable authority than Réaumur, in his "Art de faire éclore les Poulets." A Maltese couple, named Kelleia, whose hands and feet were constructed upon the ordinary human model, had born to them a son, Gratio, who possessed six perfectly movable fingers on each hand, and six toes, not quite so well formed, on each foot. No cause could be assigned for the appearance of this unusual variety of the human species.

Two circumstances are well worthy of remark in both these cases. In each, the variety appears to have arisen in full force, and, as it were, *per saltum;* a wide and definite difference appealing, at once, between the Ancon ram and the ordinary sheep; between the six-fingered and six-toed Gratio Kelleia and ordinary men. In neither case is it possible [36] to point out any obvious reason for the appearance of the variety. Doubtless there were determining causes for these as for all other phænomena; but they do not appear, and we can be tolerably certain that what are ordinarily understood as changes in physical conditions, as in climate, in food, or the like, did not take place and had nothing to do with the matter. It was no case of what is commonly called adaptation to circumstances; but, to use a conveniently erroneous phrase, the variations arose spontaneously. The fruitless search after final causes leads their pursuers a long way; but even those hardy teleologists, who are ready to break through all the laws of physics in chase of their favourite will-o'-the-wisp, may be puzzled to discover what purpose could be attained by the stunted legs of Seth Wright's ram or the hexadactyle members of Gratio Kelleia.

Varieties then arise we know not why; and it is more than probable that the majority of varieties have arisen in this "spontaneous" manner, though we are, of course, far from denying that they may be traced, in some cases, to distinct external influences; which are assuredly competent to alter the character of the tegumentary covering, to change colour, to increase or diminish the size of muscles, to modify constitution, and, among plants, to give rise to the metamorphosis of stamens into petals, and so forth. But however they may have arisen, what especially interests us at present is, to [37] remark that, once in existence, many varieties obey the fundamental law of reproduction that like tends to produce like; and their offspring exemplify it by tending to exhibit the same deviation from the parental stock as themselves. Indeed, there seems to be, in many instances, a prepotent influence about a newly-arisen variety which gives it what one may call an unfair advantage over the normal descendants from the same stock. This is strikingly exemplified by the case of Gratio Kelleia, who married a woman with the ordinary pentadactyle extremities, and had by her four children, Salvator, George, André, and Marie. Of these children Salvator, the eldest boy, had six fingers and six toes, like his father; the second and third, also boys, had five fingers and five toes, like their mother, though the hands and feet of George were slightly deformed. The last, a girl, had five fingers and five toes, but the thumbs were slightly deformed. The variety thus reproduced itself purely in the eldest, while the normal type reproduced itself purely in the third, and almost purely in the second and last: so that it would seem, at first, as if the normal type were more powerful than the variety. But all these children grew up and intermarried with normal wives and husband, and then, note what took place: Salvator had four children, three of whom exhibited the hexadactyle members of their grandfather and father, while the youngest had the pentadactyle [38] limbs of the mother and grandmother; so that here, notwithstanding a double pentadactyle dilution of the blood, the hexadactyle variety had the best of it. The same pre-potency of the variety was still more markedly exemplified in the progeny of two of the other children, Marie and George. Marie (whose thumbs only were deformed) gave birth to a boy with six toes, and three other normally formed children;

but George, who was not quite so pure a pentadactyle, begot, first, two girls, each of whom had six fingers and toes; then a girl with six fingers on each hand and six toes on the right foot, but only five toes on the left; and lastly, a boy with only five fingers and toes. In these instances, therefore, the variety, as it were, leaped over one generation to reproduce itself in full force in the next. Finally, the purely pentadactyle André was the father of many children, not one of whom departed from the normal parental type.

If a variation which approaches the nature of a monstrosity can strive thus forcibly to reproduce itself, it is not wonderful that less aberrant modifications should tend to be preserved even more strongly; and the history of the Ancon sheep is, in this respect, particularly instructive. With the "cuteness" characteristic of their nation, the neighbours of the Massachusetts farmer imagined it would be an excellent thing if all his sheep were imbued with the stay-at-home tendencies [39] enforced by Nature upon the newly-arrived ram; and they advised Wright to kill the old patriarch of his fold, and install the Ancon ram in his place. The result justified their sagacious anticipations, and coincided very nearly with what occurred to the progeny of Gratio Kelleia. The young lambs were almost always either pure Ancons, or pure ordinary sheep.[3] But when sufficient Ancon sheep were obtained to interbreed with one another, it was found that the offspring was always pure Ancon. Colonel Humphreys, in fact, states that he was acquainted with only "one questionable case of a contrary nature." Here, then, is a remarkable and well-established instance, not only of a very distinct race being established *per saltum,* but of that race breeding "true" at once, and showing no mixed forms, even when crossed with another breed.[3]

By taking care to select Ancons of both sexes, for breeding from, it thus became easy to establish an extremely well-marked race; so peculiar that, [40] even when herded with other sheep, it was noted that the Ancons kept together. And there is every reason to believe that the existence of this breed might have been indefinitely protracted; but the introduction of the Merino sheep, which were not only very superior to the Ancons in wool and meat, but quite as quiet and orderly, led to the complete neglect of the new breed, so that, in 1813, Colonel Humphreys found it difficult to obtain the specimen, the skeleton of which was presented to Sir Joseph Banks. We believe that, for many years, no remnant of it has existed in the United States.

Gratio Kelleia was not the progenitor of a race of six-fingered men, as Seth Wright's ram became a nation of Ancon sheep, though the tendency of the variety to perpetuate itself appears to have been fully as strong in the one case as in the other. And the reason of the difference is not far to seek. Seth Wright took care not to weaken the Ancon blood by matching his Ancon ewes with any but males of the same variety, while Gratio Kelleia's sons were too far removed from the patriarchal times to intermarry with their sisters; and his grand-children seem not to have been attracted by their six-fingered cousins. In other words, in the one example a race was produced, because, for several generations, care was taken to *select* both parents of the breeding stock from animals exhibiting a tendency to vary in the [41] same direction; while, in the other, no race was evolved, because no such selection was exercised. A race is a propagated variety; and as, by the laws of reproduction, offspring tend to assume the parental forms, they will be more likely to propagate a variation exhibited by both parents than that possessed by only one.

There is no organ of the body of an animal which may not, and does not, occasionally, vary more or less from the normal type; and there is no variation which may not be transmitted and which, if selectively transmitted, may not become the foundation of a race. This great truth, sometimes forgotten by philosophers, has long been familiar to practical agriculturists and breeders; and upon it rest all the methods of improving the breeds of domestic animals, which, for the last century, have been followed with so much success in England. Colour, form, size, texture of hair or wool, proportions of various parts, strength or weakness of constitution, tendency to fatten or to remain lean, to give much or little milk, speed, strength, temper, intelligence, special instincts; there is not one of these characters the transmission of which is not an every-day occurrence within the experience of cattle-breeders, stock-farmers, horse-dealers, and dog and poultry fanciers. Nay, it is only the other day that an eminent physiologist, Dr. Brown-Séquard, communicated to the Royal Society his discovery that epilepsy, artificially produced in [42] guinea-pigs, by a means which he has discovered, is transmitted to their offspring.[4]

But a race, once produced, is no more a fixed and immutable entity than the stock whence it sprang; variations arise among its members, and as these variations are transmitted like any others, new races may be developed out of the pre-existing one *ad infinitum*, or, at least, within any limit at present determined. Given sufficient time and sufficiently careful selection, and the multitude of races which may arise from a common stock is as astonishing as are the extreme structural differences which they may present. A remarkable example of this is to be found in the rock-pigeon, which Mr. Darwin has, in our opinion, satisfactorily demonstrated to be the progenitor of all our domestic pigeons, of which there are certainly more than a hundred well-marked races. The most noteworthy of these races are, the four great stocks known to the "fancy" as tumblers, pouters, carriers, and fantails; birds which not only differ most singularly in size, colour, and habits, but in the form of the beak and of the skull: in the proportions of the beak to the skull; in the number of tail-feathers; in the absolute and relative size of the feet; in the presence or absence of the uropygial gland; in the number of vertebræ in the back; in short, in precisely those characters in which [43] the genera and species of birds differ from one another.

And it is most remarkable and instructive to observe, that none of these races can be shown to have been originated by the action of changes in what are commonly called external circumstances, upon the wild rock-pigeon. On the contrary, from time immemorial pigeon-fanciers have had essentially similar methods of treating their pets, which have been housed, fed, protected and cared for in much the same way in all pigeonries. In fact, there is no case better adapted than that of the pigeons to refute the doctrine which one sees put forth on high authority, that "no other characters than those founded on the development of bone for the attachment of muscles" are capable of variation. In precise contradiction of this hasty assertion, Mr. Darwin's researches prove that the skeleton of the wings in domestic pigeons has hardly varied at all from that of the wild type; while, on the other hand, it is in exactly those respects, such as the relative length of the beak and skull, the number of the vertebræ, and the number of the tail-feathers, in which muscular exertion can have no important influence, that the utmost amount of variation has taken place.

We have said that the following out of the properties exhibited by physiological species would lead us

into difficulties, and at this point they begin [44] to be obvious; for if, as the result of spontaneous variation and of selective breeding, the progeny of a common stock may become separated into groups distinguished from one another by constant, not sexual, morphological characters, it is clear that the physiological definition of species is likely to clash with the morphological definition. No one would hesitate to describe the pouter and the tumbler as distinct species, if they were found fossil, or if their skins and skeletons were imported, as those of exotic wild birds commonly are–and without doubt, if considered alone, they are good and distinct morphological species. On the other hand, they are not physiological species, for they are descended from a common stock, the rock-pigeon.

Under these circumstances, as it is admitted on all sides that races occur in Nature, how are we to know whether any apparently distinct animals are really of different physiological species, or not, seeing that the amount of morphological difference is no safe guide? Is there any test of a physiological species? The usual answer of physiologists is in the affirmative. It is said that such a test is to be found in the phænomena of hybridisation–in the results of crossing races, as compared with the results of crossing species.

So far as the evidence goes at present, individuals, of what are certainly known to be mere races produced by selection, however distinct they may appear to be, not only breed freely together, [45] but the offspring of such crossed races are perfectly fertile with one another. Thus, the spaniel and the greyhound, the dray-horse and the Arab, the pouter and the tumbler, breed together with perfect freedom, and their mongrels, if matched with other mongrels of the same kind, are equally fertile.

On the other hand, there can be no doubt that the individuals of many natural species are either absolutely infertile if crossed with individuals of other species, or, if they give rise to hybrid offspring, the hybrids so produced are infertile when paired together. The horse and the ass, for instance, if so crossed, give rise to the mule, and there is no certain evidence of offspring ever having been produced by a male and female mule. The unions of the rock-pigeon and the ring-pigeon appear to be equally barren of result. Here, then, says the physiologist, we have a means of distinguishing any two true species from any two varieties. If a male and a female, selected from each group, produce offspring, and that offspring is fertile with others produced in the same way, the groups are races and not species. If, on the other hand, no result ensues, or if the offspring are infertile with others produced in the same way, they are true physiological species. The test would be an admirable one, if, in the first place, it were always practicable to apply it, and if, in the second, it always yielded results susceptible of a definite interpretation. Unfortunately, [46] in the great majority of cases, this touchstone for species is wholly inapplicable.

The constitution of many wild animals is so altered by confinement that they will not breed even with their own females, so that the negative results obtained from crosses are of no value; and the antipathy of wild animals of different species for one another, or even of wild and tame members of the same species, is ordinarily so great, that it is hopeless to look for such unions in Nature. The hermaphrodism of most plants, the difficulty in the way of insuring the absence of their own or the proper working of other pollen, are obstacles of no less magnitude in applying the test to them. And, in both animals and plants, is superadded the further difficulty, that experiments must be continued over a long time for the

purpose of ascertaining the fertility of the mongrel or hybrid progeny, as well as of the first crosses from which they spring.

Not only do these great practical difficulties lie in the way of applying the hybridisation test, but even when this oracle can be questioned, its replies are sometimes as doubtful as those of Delphi. For example, cases are cited by Mr. Darwin, of plants which are more fertile with the pollen of another species than with their own; and there are others, such as certain *Fuci,* the male element of which will fertilise the ovule of a plant of distinct species, while the males of the latter [47] species are ineffective with the females of the first. So that, in the last-named instance, a physiologist, who should cross the two species in one way, would decide that they were true species; while another, who should cross them in the reverse way, would, with equal justice, according to the rule, pronounce them to be mere races. Several plants, which there is great reason to believe are mere varieties, are almost sterile when crossed; while both animals and plants, which have always been regarded by naturalists as of distinct species, turn out, when the test is applied, to be perfectly fertile. Again, the sterility or fertility of crosses seems to bear no relation to the structural resemblances or differences of the members of any two groups.

Mr. Darwin has discussed this question with singular ability and circumspection, and his conclusions are summed up as follows, at page 276 of his work:–

"First crosses between forms sufficiently distinct to be ranked as species, and their hybrids, are very generally, but not universally, sterile. The sterility is of all degrees, and is often so slight that the two most careful experimentalists who have ever lived have come to diametrically opposite conclusions in ranking forms by this test. The sterility is innately variable in individuals of the same species, and is eminently susceptible of favourable and unfavourable conditions. The degree of sterility does not strictly follow systematic affinity, but is governed by several curious and complex laws. It is generally different and sometimes widely different, in reciprocal crosses [48] between the same two species. It is not always equal in degree in a first cross, and in the hybrid produced from this cross.

"In the same manner as in grafting trees, the capacity of one species or variety to take on another is incidental on generally unknown differences in their vegetative systems; so in crossing, the greater or less facility of one species to unite with another is incidental on unknown differences in their reproductive systems. There is no more reason to think that species have been specially endowed with various degrees of sterility to prevent them crossing and breeding in Nature, than to think that trees have been specially endowed with various and somewhat analogous degrees of difficulty in being grafted together, in order to prevent them becoming inarched in our forests.

"The sterility of first crosses between pure species, which have their reproductive systems perfect, seems to depend on several circumstances; in some cases largely on the early death of the embryo. The sterility of hybrids which have their reproductive systems imperfect, and which have had this system and their whole organisation disturbed by being compounded of two distinct species, seems closely allied to that sterility which so frequently affects pure species when their natural conditions of life have been disturbed. This view is supported by a parallelism of another kind: namely, that the crossing of forms, only slightly different, is favourable to the vigour and fertility of the offspring; and that slight changes in the conditions of life are apparently favourable to the vigour and fertility of all organic beings. It is not surprising that the degree of difficulty in uniting two species,

and the degree of sterility of their hybrid offspring, should generally correspond, though due to distinct causes; for both depend on the amount of difference of some kind between the species which are crossed. Nor is it surprising that the facility of effecting a first cross, the fertility of hybrids produced from it, and the capacity of being grafted together–though this latter capacity evidently depends on widely different circumstances–should all run to a certain extent parallel with the systematic affinity of the forms which are subjected to experiment; for systematic affinity [49] attempts to express all kinds of resemblance between all species.

"First crosses between forms known to be varieties, or sufficiently alike to be considered as varieties, and their mongrel offspring, are very generally, but not quite universally, fertile. Nor is this nearly general and perfect fertility surprising, when we remember how liable we are to argue in a circle with respect to varieties in a state of Nature; and when we remember that the greater number of varieties have been produced under domestication by the selection of mere external differences, and not of differences in the reproductive system. In all other respects, excluding fertility, there is a close general resemblance between hybrids and mongrels."–Pp. 276-8.

We fully agree with the general tenor of this weighty passage; but forcible as are these arguments, and little as the value of fertility or infertility as a test of species may be, it must not be forgotten that the really important fact, so far as the inquiry into the origin of species goes, is, that there are such things in Nature as groups of animals and of plants, the members of which are incapable of fertile union with those of other groups; and that there are such things as hybrids, which are absolutely sterile when crossed with other hybrids. For, if such phænomena as these were exhibited by only two of those assemblages of living objects, to which the name of species (whether it be used in its physiological or in its morphological sense) is given, it would have to be accounted for by any theory of the origin of species, and every theory which could not account for it would be, so far, imperfect.

[50] Up to this point, we have been dealing with matters of fact, and the statements which we have laid before the reader would, to the best of our knowledge, be admitted to contain a fair exposition of what is at present known respecting the essential properties of species, by all who have studied the question. And whatever may be his theoretical views, no naturalist will probably be disposed to demur to the following summary of that exposition:–

Living beings, whether animals or plants, are divisible into multitudes of distinctly definable kinds, which are morphological species. They are also divisible into groups of individuals, which breed freely together, tending to reproduce their like, and are physiological species. Normally resembling their parents, the offspring of members of these species are still liable to vary; and the variation may be perpetuated by selection, as a race, which race, in many cases, presents all the characteristics of a morphological species. But it is not as yet proved that a race ever exhibits, when crossed with another race of the same species, those phænomena of hybridisation which are exhibited by many species when crossed with other species. On the other hand, not only is it not proved that all species give rise to hybrids infertile *inter se,* but there is much reason to believe that, in crossing, species exhibit every gradation from perfect sterility to perfect fertility.

[51] Such are the most essential characteristics of species. Even were man not one of them–a member of the same system and subject to the same laws–the question of their origin, their causal connexion, that

is, with the other phænomena of the universe, must have attracted his attention, as soon as his intelligence had raised itself above the level of his daily wants.

Indeed history relates that such was the case, and has embalmed for us the speculations upon the origin of living beings, which were among the earliest products of the dawning intellectual activity of man. In those early days positive knowledge was not to be had, but the craving after it needed, at all hazards, to be satisfied, and according to the country, or the turn of thought, of the speculator, the suggestion that all living things arose from the mud of the Nile, from a primeval egg, or from some more anthropomorphic agency, afforded a sufficient resting-place for his curiosity. The myths of Paganism are as dead as Osiris or Zeus, and the man who should revive them, in opposition to the knowledge of our time, would be justly laughed to scorn; but the coeval imaginations current among the rude inhabitants of Palestine, recorded by writers whose very name and age are admitted by every scholar to be unknown, have unfortunately not yet shared their fate, but, even at this day, are regarded by nine-tenths of the civilised world as the authoritative standard of fact and the criterion [52] of the justice of scientific conclusions, in all that relates to the origin of things, and, among them, of species. In this nineteenth century, as at the dawn of modern physical science, the cosmogony of the semi-barbarous Hebrew is the incubus of the philosopher and the opprobrium of the orthodox. Who shall number the patient and earnest seekers after truth, from the days of Galileo until now, whose lives have been embittered and their good name blasted by the mistaken zeal of Bibliolaters? Who shall count the host of weaker men whose sense of truth has been destroyed in the effort to harmonise impossibilities–whose life has been wasted in the attempt to force the generous new wine of Science into the old bottles of Judaism, compelled by the outcry of the same strong party?

It is true that if philosophers have suffered, their cause has been amply avenged. Extinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed if not annihilated; scotched, if not slain. But orthodoxy is the Bourbon of the world of thought. It learns not, neither can it forget; and though, at present, bewildered and afraid to move, it is as willing as ever to insist that the first chapter of Genesis contains the beginning and the end of sound science; and to visit, with such petty [53] thunderbolts as its half-paralysed hands can hurl, those who refuse to degrade Nature to the level of primitive Judaism.

Philosophers, on the other hand, have no such aggressive tendencies. With eyes fixed on the noble goal to which "per aspera et ardua" they tend, they may, now and then, be stirred to momentary wrath by the unnecessary obstacles with which the ignorant, or the malicious, encumber, if they cannot bar, the difficult path; but why should their souls be deeply vexed? The majesty of Fact is on their side, and the elemental forces of Nature are working for them. Not a star comes to the meridian at its calculated time but testifies to the justice of their methods–their beliefs are "one with the falling rain and with the growing corn." By doubt they are established, and open inquiry is their bosom friend. Such men have no fear of traditions however venerable, and no respect for them when they become mischievous and obstructive; but they have better than mere antiquarian business in hand, and if dogmas, which ought to be fossil but are not, are not forced upon their notice, they are too happy to treat them as non-existent.

The hypotheses respecting the origin of species which profess to stand upon a scientific basis, and, as such, alone demand serious attention, are of two kinds. The one, the "special creation" hypothesis, [54] presumes every species to have originated from one or more stocks, these not being the result of the modification of any other form of living matter–or arising by natural agencies–but being produced, as such, by a supernatural creative act.

The other, the so-called "transmutation" hypothesis, considers that all existing species are the result of the modification of pre-existing species, and those of their predecessors, by agencies similar to those which at the present day produce varieties and races, and therefore in an altogether natural way; and it is a probable, though not a necessary consequence of this hypothesis, that all living beings have arisen from a single stock. With respect to the origin of this primitive stock, or stocks, the doctrine of the origin of species is obviously not necessarily concerned. The transmutation hypothesis, for example, is perfectly consistent either with the conception of a special creation of the primitive germ, or with the supposition of its having arisen, as a modification of inorganic matter, by natural causes.

The doctrine of special creation owes its existence very largely to the supposed necessity of making science accord with the Hebrew cosmogony; but it is curious to observe that, as the doctrine is at present maintained by men of science, it is as hopelessly inconsistent with the Hebrew view as any other hypothesis.

If there be any result which has come more [55] clearly out of geological investigation than another, it is, that the vast series of extinct animals and plants is not divisible, as it was once supposed to be, into distinct groups, separated by sharply-marked boundaries. There are no great gulfs between epochs and formations–no successive periods marked by the appearance of plants, of water animals, and of land animals, *en masse.* Every year adds to the list of links between what the older geologists supposed to be widely separated epochs: witness the crags linking the drift with older tertiaries; the Maestricht beds linking the tertiaries with the chalk; the St. Cassian beds exhibiting an abundant fauna of mixed mesozoic and palæozoic types, in rocks of an epoch once supposed to be eminently poor in life; witness, lastly, the incessant disputes as to whether a given stratum shall be reckoned devonian or carboniferous, silurian or devonian, cambrian or silurian.

This truth is further illustrated in a most interesting manner by the impartial and highly competent testimony of M. Pictet, from whose calculations of what percentage of the genera of animals, existing in any formation, lived during the preceding formation, it results that in no case is the proportion less than *one-third*, or 33 per cent. It is the triassic formation, or the commencement of the mesozoic epoch, which has received the smallest inheritance from preceding [56] ages. The other formations not uncommonly exhibit 60, 80, or even 94 per cent. of genera in common with those whose remains are imbedded in their predecessor. Not only is this true, but the subdivisions of each formation exhibit new species characteristic of, and found only in, them; and, in many cases, as in the lias for example, the separate beds of these subdivisions are distinguished by well-marked and peculiar forms of life. A section, a hundred feet thick, will exhibit, at different heights, a dozen species of ammonite, none of which passes beyond its particular zone of limestone, or clay, into the zone below it or into that above it; so that those who adopt the doctrine of special creation must be prepared to admit, that at intervals of

time, corresponding with the thickness of these beds, the Creator thought fit to interfere with the natural course of events for the purpose of making a new ammonite. It is not easy to transplant oneself into the frame of mind of those who can accept such a conclusion as this, on any evidence short of absolute demonstration; and it is difficult to see what is to be gained by so doing, since, as we have said, it is obvious that such a view of the origin of living beings is utterly opposed to the Hebrew cosmogony. Deserving no aid from the powerful arm of Bibliolatry, then, does the received form of the hypothesis of special creation derive any support from science or sound logic? Assuredly [57] not much. The arguments brought forward in its favour all take one form: If species were not supernaturally created, we cannot understand the facts *x* or *y,* or *z;* we cannot understand the structure of animals or plants, unless we suppose they were contrived for special ends; we cannot understand the structure of the eye, except by supposing it to have been made to see with; we cannot understand instincts, unless we suppose animals to have been miraculously endowed with them.

As a question of dialectics, it must be admitted that this sort of reasoning is not very formidable to those who are not to be frightened by consequences. It is an *argumentum ad ignorantiam*–take this explanation or be ignorant. But suppose we prefer to admit our ignorance rather than adopt a hypothesis at variance with all the teachings of Nature? Or, suppose for a moment we admit the explanation, and then seriously ask ourselves how much the wiser are we; what does the explanation explain? Is it any more than a grandiloquent way of announcing the fact, that we really know nothing about the matter? A phænomenon is explained when it is shown to be a case of some general law of Nature; but the supernatural interposition of the Creator can, by the nature of the case, exemplify no law, and if species have really arisen in this way, it is absurd to attempt to discuss their origin.

[58] Or, lastly, let us ask ourselves whether any amount of evidence which the nature of our faculties permits us to attain, can justify us in asserting that any phænomenon is out of the reach of natural causation. To this end it is obviously necessary that we should know all the consequences to which all possible combinations, continued through unlimited time, can give rise. If we knew these, and found none competent to originate species, we should have good ground for denying their origin by natural causation. Till we know them, any hypothesis is better than one which involves us in such miserable presumption.

But the hypothesis of special creation is not only a mere specious mask for our ignorance; its existence in Biology marks the youth and imperfection of the science. For what is the history of every science but the history of the elimination of the notion of creative, or other interferences, with the natural order of the phænomena which are the subject-matter of that science? When Astronomy was young "the morning stars sang together for joy," and the planets were guided in their courses by celestial hands. Now, the harmony of the stars has resolved itself into gravitation according to the inverse squares of the distances, and the orbits of the planets are deducible from the laws of the forces which allow a schoolboy's stone to break a window. The lightning was the angel of the Lord; but it has pleased [59] Providence, in these modern times, that science should make it the humble messenger of man, and we know that every flash that shimmers about the horizon on a summer's evening is determined by ascertainable conditions, and that its direction and brightness might, if our knowledge of these were great enough, have been calculated.

The solvency of great mercantile companies rests on the validity of the laws which have been ascertained to govern the seeming irregularity of that human life which the moralist bewails as the most uncertain of things; plague, pestilence, and famine are admitted, by all but fools, to be the natural result of causes for the most part fully within human control, and not the unavoidable tortures inflicted by wrathful Omnipotence upon His helpless handiwork.

Harmonious order governing eternally continuous progress–the web and woof of matter and force interweaving by slow degrees, without a broken thread, that veil which lies between us and the Infinite–that universe which alone we know or can know; such is the picture which science draws of the world, and in proportion as any part of that picture is in unison with the rest, so may we feel sure that it is rightly painted. Shall Biology alone remain out of harmony with her sister sciences?

Such arguments against the hypothesis of the direct creation of species as these are plainly [60] enough deducible from general considerations; but there are, in addition, phænomena exhibited by species themselves, and yet not so much a part of their very essence as to have required earlier mention, which are in the highest degree perplexing, if we adopt the popularly accepted hypothesis. Such are the facts of distribution in space and in time; the singular phænomena brought to light by the study of development; the structural relations of species upon which our systems of classification are founded; the great doctrines of philosophical anatomy, such as that of homology, or of the community of structural plan exhibited by large groups of species differing very widely in their habits and functions.

The species of animals which inhabit the sea on opposite sides of the isthmus of Panama are wholly distinct[5] the animals and plants which inhabit islands are commonly distinct from those of the neighbouring mainlands, and yet have a similarity of aspect. The mammals of the latest tertiary epoch in the Old and New Worlds belong to the same genera, or family groups, as those which now inhabit the same great geographical area. The crocodilian reptiles which existed in the earliest secondary epoch were similar in general structure to those now living, but exhibit slight [61] differences in their vertebræ, nasal passages, and one or two other points. The guinea-pig has teeth which are shed before it is born, and hence can never subserve the masticatory purpose for which they seem contrived, and, in like manner, the female dugong has tusks which never cut the gum. All the members of the same great group run through similar conditions in their development, and all their parts, in the adult state, are arranged according to the same plan. Man is more like a gorilla than a gorilla is like a lemur. Such are a few, taken at random, among the multitudes of similar facts which modern research has established; but when the student seeks for an explanation of them from the supporters of the received hypothesis of the origin of species, the reply he receives is, in substance, of Oriental simplicity and brevity–"Mashallah! it so pleases God!" There are different species on opposite sides of the isthmus of Panama, because they were created different on the two sides. The pliocene mammals are like the existing ones, because such was the plan of creation; and we find rudimental organs and similarity of plan, because it has pleased the Creator to set before Himself a "divine exemplar or archetype," and to copy it in His works; and somewhat ill, those who hold this view imply, in some of them. That such verbal hocus-pocus should be received as science will one day be regarded as evidence of the low state of [62] intelligence in the

nineteenth century, just as we amuse ourselves with the phraseology about Nature's abhorrence of a vacuum, wherewith Torricellis compatriots were satisfied to explain the rise of water in a pump. And be it recollected that this sort of satisfaction works not only negative but positive ill, by discouraging inquiry, and so depriving man of the usufruct of one of the most fertile fields of his great patrimony, Nature.

The objections to the doctrine of the origin of species by special creation which have been detailed, must have occurred, with more or less force, to the mind of every one who has seriously and independently considered the subject. It is therefore no wonder that, from time to time, this hypothesis should have been met by counter hypotheses, all as well, and some better founded than itself; and it is curious to remark that the inventors of the opposing views seem to have been led into them as much by the knowledge of geology, as by their acquaintance with biology. In fact, when the mind has once admitted the conception of the gradual production of the present physical state of our globe, by natural causes operating through long ages of time, it will be little disposed to allow that living beings have made their appearance in another way, and the speculations of De Maillet and his successors are the natural complement of Scilla's demonstration of the true nature of fossils.

[63] A contemporary of Newton and of Leibnitz, sharing therefore in the intellectual activity of the remarkable age which witnessed the birth of modern physical science, Benoît de Maillet spent a long life as a consular agent of the French Government in various Mediterranean ports. For sixteen years, in fact, he held the office of Consul-General in Egypt, and the wonderful phænomena offered by the valley of the Nile appear to have strongly impressed his mind, to have directed his attention to all facts of a similar order which came within his observation, and to have led him to speculate on the origin of the present condition of our globe and of its inhabitants. But, with all his ardour for science, De Maillet seems to have hesitated to publish views which, notwithstanding the ingenious attempts to reconcile them with the Hebrew hypothesis contained in the preface to "Telliamed," were hardly likely to be received with favour by his contemporaries.

But a short time had elapsed since more than one of the great anatomists and physicists of the Italian school had paid dearly for their endeavours to dissipate some of the prevalent errors; and their illustrious pupil, Harvey, the founder of modern physiology, had not fared so well, in a country less oppressed by the benumbing influences of theology, as to tempt any man to follow his example. Probably not uninfluenced by these considerations, his Catholic majesty's Consul-[64]General for Egypt kept his theories to himself throughout a long life, for "Telliamed," the only scientific work which is known to have proceeded from his pen, was not printed till 1735, when its author had reached the ripe age of seventy-nine; and though De Maillet lived three years longer, his book was not given to the world before 1748. Even then it was anonymous to those who were not in the secret of the anagrammatic character of its title; and the preface and dedication are so worded as, in case of necessity, to give the printer a fair chance of falling back on the excuse that the work was intended for a mere *jeu d'esprit.*

The speculations of the supposititious Indian sage, though quite as sound as those of many a "Mosaic Geology," which sells exceedingly well, have no great value if we consider them by the light of modern science. The waters are supposed to have originally covered the whole globe; to have deposited the

rocky masses which compose its mountains by processes comparable to those which are now forming mud, sand, and shingle; and then to have gradually lowered their level, leaving the spoils of their animal and vegetable inhabitants embedded in the strata. As the dry land appeared, certain of the aquatic animals are supposed to have taken to it, and to have become gradually adapted to terrestrial and aerial modes of existence. But if we regard the general tenor and style of the reasoning in relation to the state [65] of knowledge of the day, two circumstances appear very well worthy of remark. The first, that De Maillet had a notion of the modifiability of living forms (though without any precise information on the subject), and how such modifiability might account for the origin of species; the second, that he very clearly apprehended the great modern geological doctrine, so strongly insisted upon by Hutton, and so ably and comprehensively expounded by Lyell, that we must look to existing causes for the explanation of past geological events. Indeed, the following passage of the preface, in which De Maillet is supposed to speak of the Indian philosopher Telliamed, his *alter ego,* might have been written by the most philosophical uniformitarian of the present day:–

"Ce qu'il y a d'étonnant, est que pour arriver à ces connoissances il semble avoir perverti l'ordre naturel, puisqu'au lieu de s'attacher d'abord à rechercher l'origine de notre globe il a commencé par travailler à s'instruire de la nature. Mais à l'entendre, ce renversement de l'ordre a été pour lui l'effet d'un génie favorable qui l'a conduit pas à pas et comme par la main aux découvertes les plus sublimes. C'est en décomposant la substance de ce globe par une anatomie exacte de toutes ses parties qu'il a premièrement appris de quelles matières il était composé et quels arrangemens ces mêmes matières observaient entre elles. Ces lumières jointes à l'esprit de comparaison toujours nécessaire à quiconque entreprend de percer les voiles dont la nature aime à se cacher, ont servi de guide à notre philosophe pour parvenir à des connoissances plus intéressantes. Par la matière et l'arrangement de ces compositions il prétend [66] avoir reconnu quelle est la véritable origine de ce globe que nous habitons, comment et par qui il a été formé."–Pp. xix. xx.

But De Maillet was before his age, and as could hardly fail to happen to one who speculated on a zoological and botanical question before Linnæus, and on a physiological problem before Haller, he fell into great errors here and there; and hence, perhaps, the general neglect of his work. Robinet's speculations are rather behind, than in advance of, those of De Maillet; and though Linnæus may have played with the hypothesis of transmutation, it obtained no serious support until Lamarck adopted it, and advocated it with great ability in his "Philosophie Zoologique."

Impelled towards the hypothesis of the transmutation of species, partly by his general cosmological and geological views; partly by the conception of a graduated, though irregularly branching, scale of being, which had arisen out of his profound study of plants and of the lower forms of animal life, Lamarck, whose general line of thought often closely resembles that of De Maillet, made a great advance upon the crude and merely speculative manner in which that writer deals with the question of the origin of living beings, by endeavouring to find physical causes competent to effect that change of one species into another, which De Maillet had only supposed to occur. And Lamarck conceived that he had found in Nature such causes, amply sufficient for [67] the purpose in view. It is a physiological fact, he says, that organs are increased in size by action, atrophied by inaction; it is another physiological fact that modifications produced are transmissible to offspring. Change the actions of an animal, therefore, and you will change its structure, by increasing the development of the parts newly brought into use and by

the diminution of those less used; but by altering the circumstances which surround it you will alter its actions, and hence, in the long run, change of circumstance must produce change of organisation. All the species of animals, therefore, are, in Lamarck's view, the result of the indirect action of changes of circumstance, upon those primitive germs which he considered to have originally arisen, by spontaneous generation, within the waters of the globe. It is curious, however, that Lamarck should insist so strongly[5] as he has done, that circumstances never in any degree directly modify the form or the organisation of animals, but only operate by changing their wants and consequently their actions; for he thereby brings upon himself the obvious question, How, then, do plants, which cannot be said to have wants or actions, become modified? To this he replies, that they are modified by the changes in their nutritive processes, which are effected by changing circumstances; and it does not seem to have [68] occurred to him that such changes might be as well supposed to take place among animals.

When we have said that Lamarck felt that mere speculation was not the way to arrive at the origin of species, but that it was necessary, in order to the establishment of any sound theory on the subject, to discover by observation or otherwise, some *vera causa,* competent to give rise to them; that he affirmed the true order of classification to coincide with the order of their development one from another; that he insisted on the necessity of allowing sufficient time, very strongly; and that all the varieties of instinct and reason were traced back by him to the same cause as that which has given rise to species, we have enumerated his chief contributions to the advance of the question. On the other hand, from his ignorance of any power in Nature competent to modify the structure of animals, except the development of parts, or atrophy of them, in consequence of a change of needs, Lamarck was led to attach infinitely greater weight than it deserves to this agency, and the absurdities into which he was led have met with deserved condemnation. Of the struggle for existence, on which, as we shall see, Mr. Darwin lays such great stress, he had no conception; indeed, he doubts whether there really are such things as extinct species, unless they be such large animals as may have met their death at the [69] hands of man; and so little does he dream of there being any other destructive causes at work, that, in discussing the possible existence of fossil shells, he asks, "Pourquoi d'ailleurs seroient-ils perdues dès que l'homme n'a pu opérer leur destruction?" ("Phil. Zool.," vol. i. p. 77.) Of the influence of selection Lamarck has as little notion, and he makes no use of the wonderful phænomena which are exhibited by domesticated animals, and illustrate its powers. The vast influence of Cuvier was employed against the Lamarckian views, and, as the untenability of some of his conclusions was easily shown, his doctrines sank under the opprobrium of scientific, as well as of theological, heterodoxy. Nor have the efforts made of late years to revive them tended to re-establish their credit in the minds of sound thinkers acquainted with the facts of the case; indeed it may be doubted whether Lamarck has not suffered more from his friends than from his foes.

Two years ago, in fact, though we venture to question if even the strongest supporters of the special creation hypothesis had not, now and then, an uneasy consciousness that all was not right, their position seemed more impregnable than ever, if not by its own inherent strength, at any rate by the obvious failure of all the attempts which had been made to carry it. On the other hand, however much the few, who thought deeply on the [70] question of species, might be repelled by the generally received dogmas, they saw no way of escaping from them save by the adoption of suppositions so little justified by experiment or by observation as to be at least equally distasteful.

The choice lay between two absurdities and a middle condition of uneasy scepticism; which last, however unpleasant and unsatisfactory, was obviously the only justifiable state of mind under the circumstances.

Such being the general ferment in the minds of naturalists, it is no wonder that they mustered strong in the rooms of the Linnæan Society, on the 1st of July of the year 1858, to hear two papers by authors living on opposite sides of the globe, working out their results independently, and yet professing to have discovered one and the same solution of all the problems connected with species. The one of these authors was an able naturalist, Mr. Wallace, who had been employed for some years in studying the productions of the islands of the Indian Archipelago, and who had forwarded a memoir embodying his views to Mr. Darwin, for communication to the Linnæan Society. On perusing the essay, Mr. Darwin was not a little surprised to find that it embodied some of the leading ideas of a great work which he had been preparing for twenty years, and parts of which, containing a development of the very same views, [71] had been perused by his private friends fifteen or sixteen years before. Perplexed in what manner to do full justice both to his friend and to himself, Mr. Darwin placed the matter in the hands of Dr. Hooker and Sir Charles Lyell, by whose advice he communicated a brief abstract of his own views to the Linnæan Society, at the same time that Mr. Wallace's paper was read. Of that abstract, the work on the "Origin of Species" is an enlargement; but a complete statement of Mr. Darwin's doctrine is looked for in the large and well-illustrated work which he is said to be preparing for publication.

The Darwinian hypothesis has the merit of being eminently simple and comprehensible in principle, and its essential positions may be stated in a very few words: all species have been produced by the development of varieties from common stocks; by the conversion of these, first into permanent races and then into new species, by the process of *natural selection*, which process is essentially identical with that artificial selection by which man has originated the races of domestic animals–the *struggle for existence* taking the place of man, and exerting, in the case of natural selection, that selective action which he performs in artificial selection.

The evidence brought forward by Mr. Darwin in support of his hypothesis is of three kinds. First, [72] he endeavours to prove that species may be originated by selection; secondly, he attempts to show that natural causes are competent to exert selection; and thirdly, he tries to prove that the most remarkable and apparently anomalous phænomena exhibited by the distribution, development, and mutual relations of species, can be shown to be deducible from the general doctrine of their origin, which he propounds, combined with the known facts of geological change; and that, even if all these phænomena are not at present explicable by it, none are necessarily inconsistent with it.

There cannot be a doubt that the method of inquiry which Mr. Darwin has adopted is not only rigorously in accordance with the canons of scientific logic, but that it is the only adequate method. Critics exclusively trained in classics or in mathematics, who have never determined a scientific fact in their lives by induction from experiment or observation, prate learnedly about Mr. Darwin's method, which is not inductive enough, not Baconian enough, forsooth, for them. But even if practical acquaintance with

the process of scientific investigation is denied them, they may learn, by the perusal of Mr. Mill's admirable chapter "On the Deductive Method," that there are multitudes of scientific inquiries in which the method of pure induction helps the investigator but a very little way.

[73] "The mode of investigation," says Mr. Mill, "which, from the proved inapplicability of direct methods of observation and experiment, remains to us as the main source of the knowledge we possess, or can acquire, respecting the conditions and laws of recurrence of the more complex phænomena, is called, in its most general expression, the deductive method, and consists of three operations: the first, one of direct induction; the second, of ratiocination; and the third, of verification."

Now, the conditions which have determined the existence of species are not only exceedingly complex, but, so far as the great majority of them are concerned, are necessarily beyond our cognisance. But what Mr. Darwin has attempted to do is in exact accordance with the rule laid down by Mr. Mill; he has endeavoured to determine certain great facts inductively, by observation and experiment; he has then reasoned from the data thus furnished; and lastly, he has tested the validity of his ratiocination by comparing his deductions with the observed facts of Nature. Inductively, Mr. Darwin endeavours to prove that species arise in a given way. Deductively, he desires to show that, if they arise in that way, the facts of distribution, development, classification, &c., may be accounted for, *i.e.* may be deduced from their mode of origin, combined with admitted changes in physical geography and climate, during an indefinite period. And this explanation, or coincidence of observed with deduced facts, is, so far as it extends, a verification of the Darwinian view.

There is no fault to be found with Mr. Darwin's [74] method, then; but it is another question whether he has fulfilled all the conditions imposed by that method. Is it satisfactorily proved, in fact, that species may be originated by selection? that there is such a thing as natural selection? that none of the phænomena exhibited by species are inconsistent with the origin of species in this way? If these questions can be answered in the affirmative, Mr. Darwin's view steps out of the rank of hypotheses into those of proved theories; but, so long as the evidence at present adduced falls short of enforcing that affirmation, so long, to our minds, must the new doctrine be content to remain among the former–an extremely valuable, and in the highest degree probable, doctrine, indeed the only extant hypothesis which is worth anything in a scientific point of view; but still a hypothesis, and not yet the theory of species.

After much consideration, and with assuredly no bias against Mr. Darwin's views, it is our clear conviction that, as the evidence stands, it is not absolutely proven that a group of animals, having all the characters exhibited by species in Nature, has ever been originated by selection, whether artificial or natural. Groups having the morphological character of species–distinct and permanent races in fact–have been so produced over and over again; but there is no positive evidence, at present, that any group of animals has, by variation and selective breeding, given rise to another group [75] which was, even in the least degree, infertile with the first. Mr. Darwin is perfectly aware of this weak point, and brings forward a multitude of ingenious and important arguments to diminish the force of the objection. We admit the value of these arguments to their fullest extent; nay, we will go so far as to express our belief that experiments, conducted by a skilful physiologist, would very probably obtain the desired production of

mutually more or less infertile breeds from a common stock, in a comparatively few years; but still, as the case stands at present, this "little rift within the lute" is not to be disguised nor overlooked.

In the remainder of Mr. Darwin's argument our own private ingenuity has not hitherto enabled us to pick holes of any great importance; and judging by what we hear and read, other adventurers in the same field do not seem to have been much more fortunate. It has been urged, for instance, that in his chapters on the struggle for existence and on natural selection, Mr. Darwin does not so much prove that natural selection does occur, as that it must occur; but, in fact, no other sort of demonstration is attainable. A race does not attract our attention in Nature until it has, in all probability, existed for a considerable time, and then it is too late to inquire into the conditions of its origin. Again, it is said that there is no real analogy between the selection which takes place under domestication, by human influence, and any [76] operation which can be effected by Nature, for man interferes intelligently. Reduced to its elements, this argument implies that an effect produced with trouble by an intelligent agent must, *a fortiori*, be more troublesome, if not impossible, to an unintelligent agent. Even putting aside the question whether Nature, acting as she does according to definite and invariable laws, can be rightly called an unintelligent agent, such a position as this is wholly untenable. Mix salt and sand, and it shall puzzle the wisest of men, with his mere natural appliances, to separate all the grains of sand from all the grains of salt; but a shower of rain will effect the same object in ten minutes. And so, while man may find it tax all his intelligence to separate any variety which arises, and to breed selectively from it, the destructive agencies incessantly at work in Nature, if they find one variety to be more soluble in circumstances than the other, will inevitably, in the long run, eliminate it.

A frequent and a just objection to the Lamarckian hypothesis of the transmutation of species is based upon the absence of transitional forms between many species. But against the Darwinian hypothesis this argument has no force. Indeed, one of the most valuable and suggestive parts of Mr. Darwin's work is that in which he proves, that the frequent absence of transitions is a necessary consequence of his doctrine, and that the stock whence two or more species have sprung, need in [77] no respect be intermediate between these species. If any two species have arisen from a common stock in the same way as the carrier and the pouter, say, have arisen from the rock-pigeon, then the common stock of these two species need be no more intermediate between the two than the rock-pigeon is between the carrier and pouter. Clearly appreciate the force of this analogy, and all the arguments against the origin of species by selection, based on the absence of transitional forms, fall to the ground. And Mr. Darwin's position might, we think, have been even stronger than it is if he had not embarrassed himself with the aphorism, *"Natura non facit saltum,"* which turns up so often in his pages. We believe, as we have said above, that Nature does make jumps now and then, and a recognition of the fact is of no small importance in disposing of many minor objections to the doctrine of transmutation.

But we must pause. The discussion of Mr. Darwin's arguments in detail would lead us far beyond the limits within which we proposed, at starting, to confine this article. Our object has been attained if we have given an intelligible, however brief, account of the established facts connected with species, and of the relation of the explanation of those facts offered by Mr. Darwin to the theoretical views held by his predecessors and his contemporaries, and, above all, to the require[78]ments of scientific logic. We have ventured to point out that it does not, as yet, satisfy all those requirements; but we do not hesitate to

assert that it is as superior to any preceding or contemporary hypothesis, in the extent of observational and experimental basis on which it rests, in its rigorously scientific method, and in its power of explaining biological phænomena, as was the hypothesis of Copernicus to the speculations of Ptolemy. But the planetary orbits turned out to be not quite circular after all, and, grand as was the service Copernicus rendered to science, Kepler and Newton had to come after him. What if the orbit of Darwinism should be a little too circular? What if species should offer residual phænomena, here and there, not explicable by natural selection? Twenty years hence naturalists may be in a position to say whether this is, or is not, the case; but in either event they will owe the author of "The Origin of Species" an immense debt of gratitude. We should leave a very wrong impression on the reader's mind if we permitted him to suppose that the value of that work depends wholly on the ultimate justification of the theoretical views which it contains. On the contrary, if they were disproved to-morrow, the book would still be the best of its kind–the most compendious statement of well-sifted facts bearing on the doctrine of species that has ever appeared. The chapters on Variation, on the Struggle for [79] Existence, on Instinct, on Hybridism, on the Imperfection of the Geological Record, on Geographical Distribution, have not only no equals, but, so far as our knowledge goes, no competitors, within the range of biological literature. And viewed as a whole, we do not believe that, since the publication of Von Baer's "Researches on Development," thirty years ago, any work has appeared calculated to exert so large an influence, not only on the future of Biology, but in extending the domination of Science over regions of thought into which she has, as yet, hardly penetrated.

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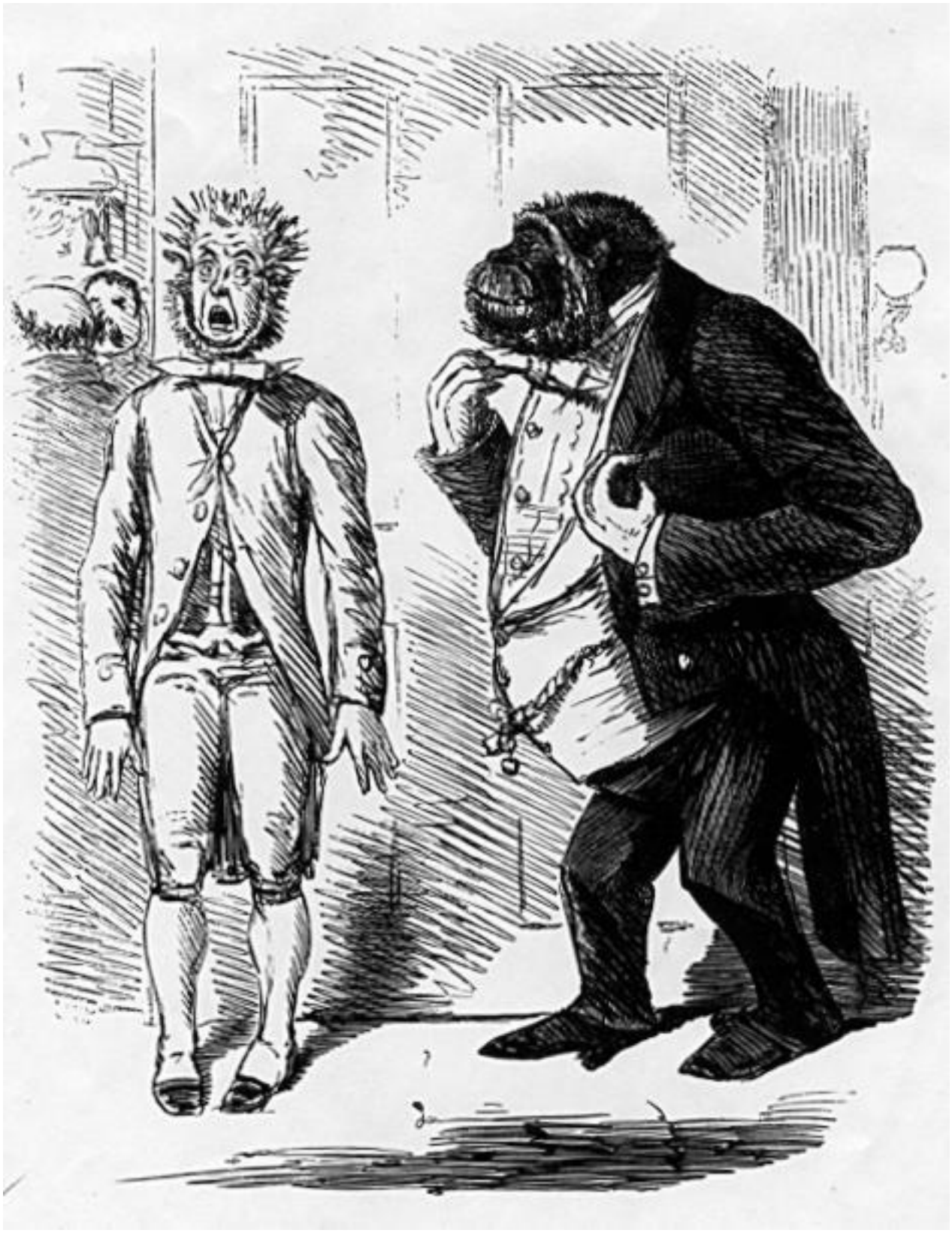
1 "On the Osteology of the Chimpanzees and Orangs"; *Transactions of the Zoological Society,* 1858.

2 [When this sentence was written, it was generally believed that the original nucleus of the egg (the germinal vesicle) disappeared.–1893.]

3 [Colonel Humphreys' statements are exceedingly explicit on this point:–"When an Ancon ewe is impregnated by a common ram, the increase resembles wholly either the ewe or the ram. The increase of the common ewe impregnated by an Ancon ram follows entirely the one or the other, without blending any of the distinguishing and essential peculiarities of both. Frequent instances have happened where common ewes have had twins by Ancon rams, when one exhibited the complete marks and features of the ewe, the other of the ram. The contrast has been rendered singularly striking, when one short-legged and one long-legged lamb, produced at a birth, have been seen sucking the dam at the same time."–*Philosophical Transactions,* 1813, Pt. I. pp. 89, 90.3 Compare Weismann's *Essays Upon Heredity,* p. 310, *et seq.* 1893.]

4 Recent investigations tend to show that this statement is not strictly accurate–1870.

5 See *Phil. Zoologique,* vol. 1, p. 222, et seq.

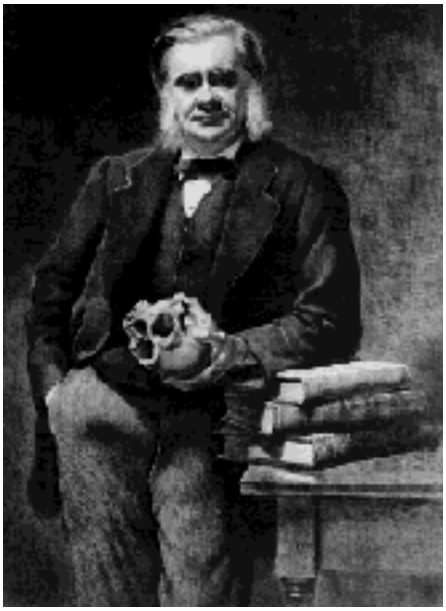


"The Lion of the Season"

Alarmed Flunkey: "Mr. G-G-G-O-O-O-RILLA"

Punch 1861

THE HUXLEY FILE



Preface and Table of Contents to Volume II, *Darwiniana,* of Huxley's *Collected Essays.*

Next article: Criticisms on "The Origin of Species" [1864], pages 80-106.

Previous article: The Darwinian Hypothesis [1859], pages 1-21.

C. Blinderman & D. Joyce
Clark University

Pope Darwin

Caricature of The Pope of Science blessing a German supplicant naturalist of the "Church Scientific," from letter to Darwin, 1868

Down House

Criticisms on "The Origin of Species"(1864)

Collected Essays II

[80] 1. Ueber die Darwin'sche Schöpfungstheorie; ein Vortrag, von A. Kölliker. Leipzig, 1864.

2. Examination du Livre de M. Darwin sur l'Origine des Espèces. Par P. Flourens. Paris, 1864.

In the course of the present year several foreign commentaries upon Mr. Darwin's great work have made their appearance. Those who have perused that remarkable chapter of the "Antiquity of Man," in which Sir Charles Lyell draws a parallel between the development of species and that of languages, will be glad to hear that one of the most eminent philologers of Germany, Professor Schleicher, has, independently, published a most instructive and philosophical pamphlet (an excellent notice of which is

to be found in the [81] *Reader,* for February 27th of this year) supporting similar views with all the weight of his special knowledge and established authority as a linguist. Professor Haeckel, to whom Schleicher addresses himself, previously took occasion, in his splendid monograph on the *Radiolaria,*[1] to express his high appreciation of, and general concordance with, Mr. Darwin's views.

But the most elaborate criticisms of the "Origin of Species" which have appeared are two works of very widely different merit, the one by Professor Kölliker, the well-known anatomist and histologist of Wurzburg; the other by M. Flourens, Perpetual Secretary of the French Academy of Sciences.

Professor Kölliker's critical essay "Upon the Darwinian Theory" is, like all that proceeds from the pen of that thoughtful and accomplished writer, worthy of the most careful consideration. It comprises a brief but clear sketch of Darwin's views, followed by an enumeration of the leading difficulties in the way of their acceptance; difficulties which would appear to be insurmountable to Professor Kölliker, inasmuch as he proposes to replace Mr. Darwin's Theory by one which he terms the "Theory of Heterogeneous Generation." We shall proceed to consider first the destructive, and secondly, the constructive portion of the essay.

[82] We regret to find ourselves compelled to dissent very widely from many of Professor Kölliker's remarks; and from none more thoroughly than from those in which he seeks to define what we may term the philosophical position of Darwinism.

"Darwin," says Professor Kölliker, "is, in the fullest sense of the word, a Teleologist. He says quite distinctly (First Edition, pp. 199, 200) that every particular in the structure of an animal has been created for its benefit, and he regards the whole series of animal forms only from this point of view."

And again:

"7. The teleological general conception adopted by Darwin is a mistaken one.

"Varieties arise irrespectively of the notion of purpose, or of utility, according to general laws of Nature, and may be either useful, or hurtful, or indifferent.

"The assumption that an organism exists only on account of some definite end in view, and represents something more than the incorporation of a general idea, or law, implies a one-sided conception of the universe. Assuredly, every organ has, and every organism fulfils, its end, but its purpose is not the condition of its existence. Every organism is also sufficiently perfect for the purpose it serves, and in that, at least, it is useless to seek for a cause of its improvement."

It is singular how differently one and the same book will impress different minds. That which struck the present writer most forcibly on his first perusal of the "Origin of Species" was the conviction that Teleology, as commonly understood, had received its deathblow at Mr. Darwin's hands. For the teleological argument runs thus: an organ [83] or organism (A) is precisely fitted to perform a function

or purpose (B); therefore it was specially constructed to perform that function. In Paley's famous illustration, the adaptation of all the parts of the watch to the function, or purpose, of showing the time, is held to be evidence that the watch was specially contrived to that end; on the ground, that the only cause we know of, competent to produce such an effect as a watch which shall keep time, is a contriving intelligence adapting the means directly to that end.

Suppose, however, that any one had been able to show that the watch had not been made directly by any person, but that it was the result of the modification of another watch which kept time but poorly; and that this again had proceeded from a structure which could hardly be called a watch at all–seeing that it had no figures on the dial and the hands were rudimentary; and that going back and back in time we came at last to a revolving barrel as the earliest traceable rudiment of the whole fabric. And imagine that it had been possible to show that all these changes had resulted, first, from a tendency of the structure to vary indefinitely; and secondly, from something in the surrounding world which helped all variations in the direction of an accurate time-keeper, and checked all those in other directions; then it is obvious that the force of Paley's argument would be gone. For it would be demonstrated that an [84] apparatus thoroughly well adapted to a particular purpose might be the result of a method of trial and error worked by unintelligent agents, as well as of the direct application of the means appropriate to that end, by an intelligent agent.

Now it appears to us that what we have here, for illustration's sake, supposed to be done with the watch, is exactly what the establishment of Darwin's Theory will do for the organic world. For the notion that every organism has been created as it is and launched straight at a purpose, Mr. Darwin substitutes the conception of something which may fairly be termed a method of trial and error. Organisms vary incessantly; of these variations the few meet with surrounding conditions which suit them and thrive; the many are unsuited and become extinguished.

According to Teleology, each organism is like a rifle bullet fired straight at a mark; according to Darwin, organisms are like grapeshot of which one hits something and the rest fall wide.

For the teleologist an organism exists because it was made for the conditions in which it is found; for the Darwinian an organism exists because, out of many of its kind, it is the only one which has been able to persist in the conditions in which it is found.

Teleology implies that the organs of every organism are perfect and cannot be improved; the Darwinian theory simply affirms that they work [85] well enough to enable the organism to hold its own against such competitors as it has met with, but admits the possibility of indefinite improvement. But an example may bring into clearer light the profound opposition between the ordinary teleological, and the Darwinian, conception.

Cats catch mice, small birds and the like, very well. Teleology tells us that they do so because they were expressly constructed for so doing–that they are perfect mousing apparatuses, so perfect and so delicately adjusted that no one of their organs could be altered, without the change involving the

alteration of all the rest. Darwinism affirms on the contrary, that there was no express construction concerned in the matter; but that among the multitudinous variations of the Feline stock, many of which died out from want of power to resist opposing influences, some, the cats, were better fitted to catch mice than others, whence they throve and persisted, in proportion to the advantage over their fellows thus offered to them.

Far from imagining that cats exist *in order* to catch mice well, Darwinism supposes that cats exist *because* they catch mice well–mousing being not the end, but the condition, of their existence. And if the cat type has long persisted as we know it, the interpretation of the fact upon Darwinian principles would be, not that the cats have remained invariable, but that such varieties as have incessantly occurred have been, on the whole, less [86] fitted to get on in the world than the existing stock.

If we apprehend the spirit of the "Origin of Species" rightly, then, nothing can be more entirely and absolutely opposed to Teleology, as it is commonly understood, than the Darwinian Theory. So far from being a "Teleologist in the fullest sense of the word," we should deny that he is a Teleologist in the ordinary sense at all; and we should say that, apart from his merits as a naturalist, he has rendered a most remarkable service to philosophical thought by enabling the student of Nature to recognise, to their fullest extent, those adaptations to purpose which are so striking in the organic world, and which Teleology has done good service in keeping before our minds, without being false to the fundamental principles of a scientific conception of the universe. The apparently diverging teachings of the Teleologist and of the Morphologist are reconciled by the Darwinian hypothesis.

But leaving our own impressions of the "Origin of Species," and turning to those passages especially cited by Professor Kölliker, we cannot admit that they bear the interpretation he puts upon them. Darwin, if we read him rightly, does *not* affirm that every detail in the structure of an animal has been created for its benefit. His words are (p. 199):–

"The foregoing remarks lead me to say a few words on the protest lately made by some naturalists against the utilitarian doctrine that every detail of structure has been produced for the [87] good of its possessor. They believe that very many structures have been created for beauty in the eyes of man, or for mere variety. This doctrine, if true, would be absolutely fatal to my theory–yet I fully admit that many structures are of no direct use to their possessor."

And after sundry illustrations and qualifications, he concludes (p. 200):–

"Hence every detail of structure in every living creature (making some little allowance for the direct action of physical conditions) may be viewed either as having been of special use to some ancestral form, or as being now of special use to the descendants of this form–either directly, or indirectly, through the complex laws of growth."

But it is one thing to say, Darwinically, that every detail observed in an animal's structure is of use to it, or has been of use to its ancestors; and quite another to affirm, teleologically, that every detail of an animal's structure has been created for its benefit. On the former hypothesis, for example, the teeth of the fœtal *Balæna* have a meaning; on the latter, none. So far as we are aware, there is not a phrase in the

"Origin of Species" inconsistent with Professor Kölliker's position, that "varieties arise irrespectively of the notion of purpose, or of utility, according to general laws of Nature, and may be either useful, or hurtful, or indifferent."

On the contrary, Mr. Darwin writes (Summary of Chap. V.):–

"Our ignorance of the laws of variation is profound. Not in one case out of a hundred can we pretend to assign any reason why this or that part varies more or less from the same part in [88] the parents. . . The external conditions of life, as climate and food, &c., seem to have induced some slight modifications. Habit, in producing constitutional differences, and use, in strengthening, and disuse, in weakening and diminishing organs, seem to have been more potent in their effects."

And finally, as if to prevent all possible misconception, Mr. Darwin concludes his Chapter on Variation with these pregnant words:–

"Whatever the cause may be of each slight difference in the offspring from their parents–and a cause for each must exist–it is the steady accumulation, through natural selection of such differences, when beneficial to the individual, that gives rise to all the more important modifications of structure, by which the innumerable beings on the face of the earth are enabled to struggle with each other, and the best adapted to survive."

We have dwelt at length upon this subject, because of its great general importance, and because we believe that Professor Kölliker's criticisms on this head are based upon a misapprehension of Mr. Darwin's views–substantially they appear to us to coincide with his own. The other objections which Professor Kolliker enumerates and discusses are the following:[2]

"1. No transitional forms between existing species are known; and known varieties, whether selected or spontaneous, never go so far as to establish new species."

To this Professor Kölliker appears to attach some weight. He makes the suggestion that the [89] short-faced tumbler pigeon may be a pathological product.

"2. No transitional forms of animals are met with among the organic remains of earlier epochs."

Upon this, Professor Kölliker remarks that the absence of transitional forms in the fossil world. though not necessarily fatal to Darwin's views, weakens his case.

"3. The struggle for existence does not take place."

To this objection, urged by Pelzeln, Kölliker, very justly, attaches no weight.

"4. A tendency of organisms to give rise to useful varieties, and a natural selection, do not exist.

"The varieties which are found arise in consequence of manifold external influences, and it is not obvious why they all, or partially, should be particularly useful. Each animal suffices for its own ends, is perfect of its kind, and needs no further development. Should, however, a variety be useful and even maintain itself, there is no obvious reason why it should change any further. The whole conception of the imperfection of organisms and the necessity of their becoming perfected is plainly the weakest side of Darwin's Theory, and a *pis aller* (Nothbehelf) because Darwin could think of no other principle by which to explain the metamorphoses which, as I also believe, have occurred."

Here again we must venture to dissent completely from Professor Kölliker's conception of Mr. Darwin's hypothesis. It appears to us to be one of the many peculiar merits of that hypothesis that it involves no belief in a necessary and continual progress of organisms.

Again, Mr. Darwin, if we read him aright, [90] assumes no special tendency of organisms to give rise to useful varieties, and knows nothing of needs of development, or necessity of perfection. What he says is, in substance: All organisms vary. It is in the highest degree improbable that any given variety should have exactly the same relations to surrounding conditions as the parent stock. In that case it is either better fitted (when the variation may be called useful), or worse fitted, to cope with them. If better, it will tend to supplant the parent stock; if worse, it will tend to be extinguished by the parent stock.

If (as is hardly conceivable) the new variety is so perfectly adapted to the conditions that no improvement upon it is possible,–it will persist, because, though it does not cease to vary, the varieties will be inferior to itself.

If, as is more probable, the new variety is by no means perfectly adapted to its conditions, but only fairly well adapted to them, it will persist, so long as none of the varieties which it throws off are better adapted than itself.

On the other hand, as soon as it varies in a useful way, *i.e.* when the variation is such as to adapt it more perfectly to its conditions, the fresh variety will tend to supplant the former.

So far from a gradual progress towards perfection forming any necessary part of the Darwinian creed, it appears to us that it is perfectly consistent with indefinite persistence in one state, or with [91] a gradual retrogression. Suppose, for example, a return of the glacial epoch and a spread of polar climatal conditions over the whole globe. The operation of natural selection under these circumstances would tend, on the whole, to the weeding out of the higher organisms and the cherishing of the lower forms of life. Cryptogamic vegetation would have the advantage over Phanerogamic; *Hydrozoa* over corals; *Crustacea* over *Insecta,* and *Amphipoda* and *Isopoda* over the higher *Crustacea;* Cetaceans and Seals over the *Primates;* the civilisation of the Esquimaux over that of the European.

"5. Pelzeln has also objected that if the later organisms have proceeded from the earlier, the whole developmental series, from the simplest to the highest, could not now exist; in such a case the simpler organisms must have disappeared."

To this Professor Kölliker replies, with perfect justice, that the conclusion drawn by Pelzeln does not really follow from Darwin's premises, and that, if we take the facts of Palæontology as they stand, they rather support than oppose Darwin's theory.

"6. Great weight must be attached to the objection brought forward by Huxley, otherwise a warm supporter of Darwin's hypothesis, that we know of no varieties which are sterile with one another, as is the rule among sharply distinguished animal forms.

"If Darwin is right, it must be demonstrated that forms may be produced by selection, which, like the present sharply distinguished animal forms, are infertile, when coupled with one another, and this has not been done."

[92] The weight of this objection is obvious; but our ignorance of the conditions of fertility and sterility, the want of carefully conducted experiments extending over long series of years, and the strange anomalies presented by the results of the cross-fertilisation of many plants, should all, as Mr. Darwin has urged, be taken into account in considering it.

The seventh objection is that we have already discussed (*supra,* p. 82).

The eighth and last stands as follows:–

"8. The developmental theory of Darwin is not needed to enable us to understand the regular harmonious progress of the complete series of organic forms from the simpler to the more perfect.

"The existence of general laws of Nature explains this harmony, even if we assume that all beings have arisen separately and independent of one another. Darwin forgets that inorganic nature, in which there can be no thought of genetic connexion of forms, exhibits the same regular plan, the same harmony, as the organic world; and that, to cite only one example, there is as much a natural system of minerals as of plants and animals."

We do not feel quite sure that we seize Professor Kölliker's meaning here, but he appears to suggest that the observation of the general order and harmony which pervade inorganic nature, would lead us to anticipate a similar order and harmony in the organic world. And this is no doubt true, but it by no means follows that the particular order and harmony observed among them should be that which we see. Surely the [93] stripes of dun horses, and the teeth of the fœtal *Balæna,* are not explained by the "existence of general laws of Nature." Mr. Darwin endeavours to explain the exact order of organic nature which exists; not the mere fact that there is some order.

And with regard to the existence of a natural system of minerals; the obvious reply is that there may be a natural classification of any objects–of stones on a sea-beach, or of works of art; a natural classification being simply an assemblage of objects in groups, so as to express their most important and fundamental resemblances and differences. No doubt Mr. Darwin believes that those resemblances and differences upon which our natural systems or classifications of animals and plants are based, are resemblances and differences which have been produced genetically, but we can discover no reason for supposing that he denies the existence of natural classifications of other kinds.

And, after all, is it quite so certain that a genetic relation may not underlie the classification of minerals? The inorganic world has not always been what we see it. It has certainly had its metamorphoses, and, very probably, a long "Entwickelungsgeschichte" out of a nebular blastema. Who knows how far that amount of likeness among sets of minerals, in virtue of which they are now grouped into families and orders, [94] may not be the expression of the common conditions to which that particular patch of nebulous fog, which may have been constituted by their atoms, and of which they may be, in the strictest sense, the descendants, was subjected?

It will be obvious from what has preceded, that we do not agree with Professor Kölliker in thinking the objections which he brings forward so weighty as to be fatal to Darwin's view. But even if the case were otherwise, we should be unable to accept the "Theory of Heterogeneous Generation" which is offered as a substitute. That theory is thus stated:–

"The fundamental conception of this hypothesis is, that, under the influence of a general law of development, the germs of organisms produce others different from themselves. This might happen (1) by the fecundated ova passing, in the course of their development, under particular circumstances, into higher forms; (2) by the primitive and later organisms producing other organisms without fecundation, out of germs or eggs (Parthenogenesis)."

In favour of this hypothesis, Professor Kölliker adduces the well-known facts of Agamogenesis, or "alternate generation"; the extreme dissimilarity of the males and females of many animals; and of the males, females, and neuters of those insects which live in colonies: and he defines its relations to the Darwinian theory as follows:–

"It is obvious that my hypothesis is apparently very similar to Darwin's, inasmuch as I also consider that the various forms of animals have proceeded directly from one another. My hypothesis of the creation of organisms by heterogeneous genera[95]tion, however, is distinguished very essentially from Darwin's by the entire absence of the principle of useful variations and their natural selection: and my fundamental conception is this, that a great plan of development lies at the foundation of the origin of the whole organic world, impelling the simpler forms to more and more complex developments. How this law operates, what influences determine the development of the eggs and germs, and impel them to assume constantly new forms, I naturally cannot pretend to say; but I can at least adduce the great analogy of the alternation of generations. If a *Bipinnaria,* a *Brachiolaria,* a *Pluteus,* is competent to produce the Echinoderm, which is so widely different from it; if a hydroid polype can produce the higher Medusa; if the vermiform Trematode 'nurse' can develop within itself the very unlike *Cercaria,* it will not appear impossible that the egg, or ciliated embryo, of a sponge, for once, under special conditions, might become a hydroid polype, or the embryo of a Medusa, an Echinoderm."

It is obvious, from these extracts, that Professor Kölliker's hypothesis is based upon the supposed existence of a close analogy between the phænomena of Agamogenesis and the production of new species from pre-existing ones. But is the analogy a real one? We think that it is not, and, by the hypothesis cannot be.

For what are the phænomena of Agamogenesis, stated generally? An impregnated egg develops into a

sexless form, A; this gives rise, non-sexually, to a second form or forms, B, more or less different from A. B may multiply non-sexually again; in the simpler cases, however, it does not, but, acquiring sexual characters, produces impregnated eggs from whence A, once more, arises.

[96] No case of Agamogenesis is known in which *when A differs widely from B*, it is itself capable of sexual propagation. No case whatever is known in which the progeny of B, by sexual generation, is other than a reproduction of A.

But if this be a true statement of the nature of the process of Agamogenesis, how can it enable us to comprehend the production of new species from already existing ones? Let us suppose Hyænas to have preceded Dogs, and to have produced the latter in this way. Then the Hyæna will represent A, and the Dog, B. The first difficulty that presents itself is that the Hyæna must be non-sexual, or the process will be wholly without analogy in the world of Agamogenesis. But passing over this difficulty, and supposing a male and female Dog to be produced at the same time from the Hyæna stock, the progeny of the pair, if the analogy of the simpler kinds of Agamogenesis[3] is to be followed, should be a litter, not of puppies, but of young Hyænas. For the Agamogenetic series is [97] always, as we have seen, A : B : A : B, &c.; whereas, for the production of a new species, the series must be A : B : B : B, &c. The production of new species, or genera, is the extreme permanent divergence from the primitive stock. All known Agamogenetic processes, on the other hand, end in a complete return to the primitive stock. How then is the production of new species to be rendered intelligible by the analogy of Agamogenesis?

The other alternative put by Professor Kölliker–the passage of fecundated ova in the course of their development into higher forms–would, if it occurred, be merely an extreme case of variation in the Darwinian sense, greater in degree than, but perfectly similar in kind to, that which occurred when the well-known Ancon Ram was developed from an ordinary Ewe's ovum. Indeed we have always thought that Mr. Darwin has unnecessarily hampered himself by adhering so strictly to his favourite "Natura non facit saltum." We greatly suspect that she does make considerable jumps in the way of variation now and then, and that these saltations give rise to some of the gaps which appear to exist in the series of known forms.

Strongly and freely as we have ventured to disagree with Professor Kölliker, we have always done so with regret, and we trust without violating that respect which is due, not only to his scientific eminence and to the careful study which he has [98] devoted to the subject, but to the perfect fairness of his argumentation, and the generous appreciation of the worth of Mr. Darwin's labours which he always displays. It would be satisfactory to be able to say as much for M. Flourens.

But the Perpetual Secretary of the French Academy of Sciences deals with Mr. Darwin as the first Napoleon would have treated an "ideologue;" and while displaying a painful weakness of logic and shallowness of information, assumes a tone of authority, which always touches upon the ludicrous, and sometimes passes the limits of good breeding.

For example (p. 56):–

"M. Darwin continue: 'Aucune distinction absolue n'a été et ne pout être établie entre les espèces et les variétés.' Je vous ai déjà dit que trompiez; une distinction absolue sépare les varietes d'avec les espèces."

"*Je vous ai déjàdit;* moi, M. le Secrétaire perpétuel de l'Académie des Sciences: et vous

"'Qui n'êtes rien,

Pas même Académicien;'

what do you mean by asserting the contrary?" Being devoid of the blessings of an Academy in England, we are unaccustomed to see our ablest men treated in this fashion, even by a "Perpetual Secretary."

Or again, considering that if there is any one quality of Mr. Darwin's work to which friends and foes have alike borne witness, it is his candour and [99] fairness in admitting and discussing objections, what is to be thought of M. Flourens' assertion, that

"M. Darwin ne cite que les auteurs qui partagent ses opinions." (P. 40.)

Once more (p. 65):–

"Enfin l'ouvrage de M. Darwin a paru. On ne peut qu'être frappé du talent de l'auteur. Mais que d'idées obscures, que d'idées fausses! Quel jargon métaphysique jeté mal à propos dans l'histoire naturelle, qui tombe dans le galimatias dès qu'elle sort des idées claires, des idées justes! Quel langage prétentieux et vide! Quelles personnifications puériles et surnanées! O lucidité! O solidité de l'esprit Français, que devenez-vous?"

"Obscure ideas," "metaphysical jargon," "pretentious and empty language," "puerile and superannuated personifications." Mr. Darwin has many and hot opponents on this side of the Channel and in Germany, but we do not recollect to have found precisely these sins in the long catalogue of those hitherto laid to his charge. It is worth while, therefore, to examine into these discoveries effected solely by the aid of the "lucidity and solidity" of the mind of M. Flourens.

According to M. Flourens, Mr. Darwin's great error is that he has personified Nature (p. 10), and further that he has

"imagined a natural selection: he imagines afterwards that this power of selecting (*pouvoir d'élire*) which he gives to Nature is similar to the power of man. These two suppositions ad[100]mitted, nothing stops him: he plays with Nature as he likes, and makes her do all he pleases." (P. 6.)

And this is the way M. Flourens extinguishes natural selection:

"Voyons donc encore une fois, ce qu'il peut y avoir de fondé dans ce qu'on nomme *élection naturelle.*

"*L'élection naturelle* n'est sous un autre nom que la nature. Pour un être organisé, la nature n'est que l'organisation, ni plus ni moins.

"Il faudra donc aussi personnifier *l'organisation,* et dire que *l'organisation* choisit *l'organisation. L'élection naturelle* est cette *forme substantielle* dont on jouait autrefois avec tant de facilité. Aristote disait que 'Si l'art de bâtir était dans le bois, cet art agirait comme la nature.' A la place de *l'art de bâtir* M. Darwin met *l'élection naturelle,* et c'est tout un: l'uin n'est pas plus chimérique que l'autre." (P.31.)

And this is really all that M. Flourens can make of Natural Selection. We have given the original, in fear lest a translation should be regarded as a travesty; but with the original before the reader, we may try to analyse the passage. "For an organised being, Nature is only organisation, neither more nor less."

Organised beings then have absolutely no relation to inorganic nature: a plant does not, depend on soil or sunshine, climate, depth in the ocean, height above it; the quantity of saline matters in water have no influence upon animal life; the substitution of carbonic acid for oxygen in our atmosphere would hurt nobody! That these are absurdities no one should know better [101] than M. Flourens; but they are logical deductions from the assertion just quoted, and from the further statement that natural selection means only that "organisation chooses and selects organisation."

For if it be once admitted (what no sane man denies) that the chances of life of any given organism are increased by certain conditions (A) and diminished by their opposites (B), then it is mathematically certain that any change of conditions in the direction of (A) will exercise a selective influence in favour of that organism, tending to its increase and multiplication, while any change in the direction of (B) will exercise a selective influence against that organism, tending to its decrease and extinction.

Or, on the other hand, conditions remaining the same, let a given organism vary (and no one doubts that they do vary) in two directions: into one form (*a*) better fitted to cope with these conditions than the original stock, and a second (*b*) less well adapted to them. Then it is no less certain that the conditions in question must exercise a selective influence in favour of (*a*) and against (*b*), so that (*a*) will tend to predominance, and (*b*) to extirpation.

That M. Flourens should be unable to perceive the logical necessity of these simple arguments, which lie at the foundation of all Mr. Darwin's reasoning; that he should confound an irrefragable [102] deduction from the observed relations of organisms to the conditions which lie around them, with a metaphysical "forme substantielle," or a chimerical personification of the powers of Nature, would be incredible, were it not that other passages of his work leave no room for doubt upon the subject.

"On imagine une *élection naturelle* que, pourplus de ménagement, on me dit être *inconsciente,* sans s'apercevoir que le contresens littéral est précisément là: *élection inconsciente.*" (P. 52.)

"J'ai déjà dit ce qu'il faut penser de *l'élection naturelle.* Ou *l'élection naturelle* n'est rien, ou c'est la nature: mais la nature douée *d'élection,* mais la nature personnifiée: dernière erreur du dernier siècle: Le xix^{e} fait plus de

personnifications." (P. 53.)

M. Flourens cannot imagine an unconscious selection–it is for him a contradiction in terms. Did M. Flourens ever visit one of the prettiest watering-places of "la belle France," the Baie d'Arcachon? If so, he will probably have passed through the district of the Landes, and will have had an opportunity of observing the formation of "dunes" on a grand scale. What are these "dunes"? The winds and waves of the Bay of Biscay have not much consciousness, and yet they have with great care "selected," from among an infinity of masses of silex of all shapes and sizes, which have been submitted to their action, all the grains of sand below a certain size, and have heaped them by themselves over a great area. This sand has been "unconsciously selected" from [103] amidst the gravel in which it first lay with as much precision as if man had "consciously selected" it by the aid of a sieve. Physical Geology is full of such selections–of the picking out of the soft from the hard, of the soluble from the insoluble, of the fusible from the infusible, by natural agencies to which we are certainly not in the habit of ascribing consciousness.

But that which wind and sea are to a sandy beach, the sum of influences, which we term the "conditions of existence," is to living organisms. The weak are sifted out from the strong. A frosty night "selects" the hardy plants in a plantation from among the tender ones as effectually as if it were the wind, and they, the sand and pebbles, of our illustration; or, on the other hand, as if the intelligence of a gardener had been operative in cutting the weaker organisms down. The thistle, which has spread over the Pampas, to the destruction of native plants, has been more effectually "selected" by the unconscious operation of natural conditions than if a thousand agriculturists had spent their time in sowing it.

It is one of Mr. Darwin's many great services to Biological science that he has demonstrated the significance of these facts. He has shown that–given variation and given change of conditions–the inevitable result is the exercise of such an influence upon organisms that one is helped and another is impeded; one tends to predominate, [104] another to disappear; and thus the living world bears within itself, and is surrounded by, impulses towards incessant change.

But the truths just stated are as certain as any other physical laws, quite independently of the truth, or falsehood, of the hypothesis which Mr. Darwin has based upon them; and that M. Flourens, missing the substance and grasping at a shadow, should be blind to the admirable exposition of them, which Mr. Darwin has given, and see nothing there but a "dernière erreur du dernier siècle "–a personification of Nature–leads us indeed to cry with him: "O lucidité! O solidité de l'esprit Français, que devenez-vous?"

M. Flourens has, in fact, utterly failed to comprehend the first principles of the doctrine which he assails so rudely. His objections to details are of the old sort, so battered and hackneyed on this side of the Channel, that not even a Quarterly Reviewer could be induced to pick them up for the purpose of pelting Mr. Darwin over again. We have Cuvier and the mummies; M. Roulin and the domesticated animals of America; the difficulties presented by hybridism and by Palæontology; Darwinism a *rifacciamento* of De Maillet and Lamarck; Darwinism a system without a commencement, and its author bound to believe in M. Pouchet, &c. &c. How one knows it all by heart, and with what relief one reads at p. 65–

"Je laisse M. Darwin!"

[105] But we cannot leave M. Flourens without calling our readers' attention to his wonderful tenth chapter, "De la Préexistence des Germes et de l'Epigénèse," which opens thus:–

"Spontaneous generation is only a chimæra. This point established, two hypotheses remain: that of *pre-existence* and that of *epigenesis.* The one of these hypotheses has as little foundation as the other." (P. 163.)

"The doctrine of *epigenesis* is derived from Harvey: following by ocular inspection the development of the new being in the Windsor does, he saw each part appear successively, and taking the moment of *appearance* for the moment of *formation* he imagined *epigenesis.*" (P. 165.)

On the contrary, says M. Flourens (p. 167),

"The new being is formed at a stroke (*tout d'un coup*) as a whole, instantaneously; it is not formed part by part, and at different times. It is formed at once at the single *individual* moment at which the conjunction of the male and female elements takes place."

It will be observed that M. Flourens uses language which cannot be mistaken. For him, the labours of von Baer, of Rathke, of Coste, and their contemporaries and successors in Germany, France, and England, are non-existent: and, as Darwin "*imagina*" natural selection, so Harvey "*imagina*" that doctrine which gives him an even greater claim to the veneration of posterity than his better known discovery of the circulation of the blood.

Language such as that we have quoted is, in fact, so preposterous, so utterly incompatible with [106] anything but absolute ignorance of some of the best established facts, that we should have passed it over in silence had it not appeared to afford some clue to M. Flourens' unhesitating, *a priori,* repudiation of all forms of the doctrine of progressive modification of living beings. He whose mind remains uninfluenced by an acquaintance with the phænomena of development, must indeed lack one of the chief motives towards the endeavour to trace a genetic relation between the different existing forms of life. Those who are ignorant of Geology, find no difficulty in believing that the world was made as it is; and the shepherd, untutored in history, sees no reason to regard the green mounds which indicate the site of a Roman camp, as aught but part and parcel of the primæval hill-side. So M. Flourens, who believes that embryos are formed "tout d'un coup," naturally finds no difficulty in conceiving that species came into existence in the same way.

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[1] *Die Radiolarien: eine Monographie,* p. 231.

[2] Space will not allow us to give Professor Kölliker's arguments in detail; our readers will find a full and accurate version of them in the *Reader* for August 13th and 20th, 1864.

[3] If, on the contrary, we follow the analogy of the more complex forms of Agamogenesis, such as that exhibited by some *Trematoda* and by the *Aphides*, the Hyæna must produce, nonsexually, a brood of sexless Dogs, from which other sexless Dogs must proceed. At the end of a certain number of terms of the series, the Dogs would acquire sexes and generate young but these young would be, not Dogs, but Hyænas. In fact, we have demonstrated, in Agamogenetic phænomena, that inevitable recurrence to the original type, which is asserted to be true of variations in general, by Mr. Darwin's opponents; and which, if the assertion could be changed into a demonstration would, in fact, be fatal to his hypothesis.

THE HUXLEY FILE

Preface and Table of Contents to Volume II, *Darwiniana*, of Huxley's *Collected Essays.*

Next article: The Genealogy of Animals [1869], pages 107-119.

Previous article: The Origin of Species [1860], pages 22-79.

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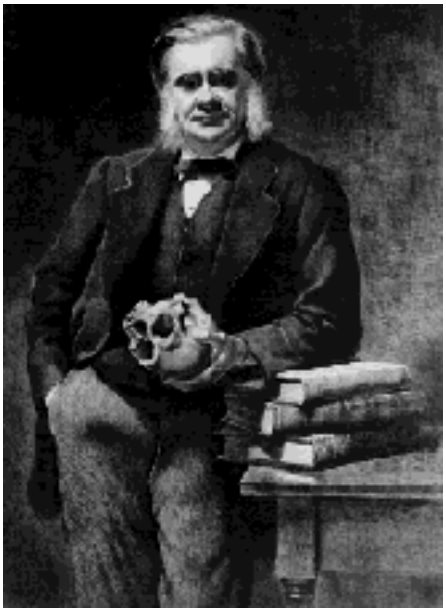

The Genealogy of Animals[1] (1869)

Collected Essays II

[107] Considering that Germany now takes the lead of the world in scientific investigation, and particularly in biology, Mr. Darwin must be well pleased at the rapid spread of his views among some of the ablest and most laborious of German naturalists.

Among these, Professor Haeckel, of Jena, is the Coryphæus. I know of no more solid and important contributions to biology in the past seven years than Haeckel's work on the "Radiolaria," and the researches of his distinguished colleague Gegenbaur, in vertebrate anatomy; while in Haeckel's "Generelle Morphologie" there is all the force, suggestiveness, and, what I may term [108] the systematising power, of Oken, without his extravagance. The "Generelle Morphologie" is, in fact, an attempt to put the Doctrine of Evolution, so far as it applies to the living world, into a logical form; and to work out its practical applications to their final results. The work before us, again, may be said to be an exposition of the "Generelle Morphologie" for an educated public, consisting, as it does, of the substance of a series of lectures delivered before a mixed audience at Jena, in the session 1867-8.

"The Natural History of Creation,"–or, as Professor Haeckel admits it would have been better to call his work, "The History of the Development or Evolution of Nature,"–deals, in the first six lectures, with the general and historical aspects of the question and contains a very interesting and lucid account of the views of Linnæus, Cuvier, Agassiz, Goethe, Oken, Kant, Lamarck, Lyell, and Darwin, and of the historical filiation of these philosophers.

The next six lectures are occupied by a well-digested statement of Mr. Darwin's views. The thirteenth lecture discusses two topics which are not touched by Mr. Darwin, namely, the origin of the present form of the solar system, and that of living matter. Full justice is done to Kant, as the originator of that "cosmic gas theory," as the Germans somewhat quaintly call it, which is commonly ascribed to Laplace. With respect to [109] spontaneous generation, while admitting that there is no experimental evidence in its favour, Professor Haeckel denies the possibility of disproving it, and points out that the assumption that it has occurred is a necessary part of the doctrine of Evolution. The fourteenth lecture, on "Schöpfungs-Perioden und Schöpfungs-Urkunden," answers pretty much to the famous disquisition on the "Imperfection of the Geological Record" in the "Origin of Species."

The following five lectures contain the most original matter of any, being devoted to "Phylogeny," or the working out of the details of the process of Evolution in the animal and vegetable kingdoms, so as to prove the line of descent of each group of living beings, and to furnish it with its proper genealogical tree, or "phylum."

The last lecture considers objections and sums up the evidence in favour of biological Evolution.

I shall best testify to my sense of the value of the work thus briefly analysed if I now proceed to note down some of the more important criticisms which have been suggested to me by its perusal.

I. In more than one place, Professor Haeckel enlarges upon the service which the "Origin of Species" has done, in favouring what he terms the "causal or mechanical" view of living nature as opposed to the "teleological or vitalistic" view. And no doubt it is quite true that the doctrine of Evolution is the most formidable opponent of all [110] the commoner and coarser forms of Teleology. But perhaps the most remarkable service to the philosophy of Biology rendered by Mr. Darwin is the reconciliation of Teleology and Morphology, and the explanation of the facts of both which his views offer.

The Teleology which supposes that the eye, such as we see it in man or one of the higher *Vertebrata*, was made with the precise structure which it exhibits, for the purpose of enabling the animal which possesses it to see, has undoubtedly received its death-blow. Nevertheless it is necessary to remember that there is a wider Teleology, which is not touched by the doctrine of Evolution, but is actually based upon the fundamental proposition of Evolution. That proposition is, that the whole world, living and not living, in the result of the mutual interaction, according to definite laws, of the forces possessed by the molecules of which the primitive nebulosity of the universe was composed. If this be true, it is no less certain that the existing world lay, potentially, in the cosmic vapour; and that a sufficient intelligence could, from a knowledge of the properties of the molecules of that vapour, have predicted, say the state of the Fauna of Britain in 1869, with as much certainty as one can say what will happen to the vapour of the breath in a cold winter's day.

Consider a kitchen clock, which ticks loudly, shows the hours, minutes, and seconds, strikes, [111] cries "cuckoo!" and perhaps shows the phases of the moon. When the clock is wound up, all the phenomena which it exhibits are potentially contained in its mechanism, and a clever clockmaker could predict all it will do after an examination of its structure.

If the evolution theory is correct, the molecular structure of the cosmic gas stands in the same relation to the phenomena of the world as the structure of the clock to its phenomena.

Now let us suppose a death-watch, living in the clock-case, to be a learned and intelligent student of its works. He might say, "I find here nothing but matter and force and pure mechanism from beginning to end," and he would be quite right. But if he drew the conclusion that the clock was not contrived for a purpose, he would be quite wrong. On the other hand, imagine another death-watch of a different turn of mind. He, listening to the monotonous "tick! tick!" so exactly like his own, might arrive at the conclusion that the clock was itself a monstrous sort of death-watch, and that its final cause and purpose was to tick. How easy to point to the clear relation of the whole mechanism to the pendulum, to the fact that the one thing the clock did always and without intermission was to tick, and that all the rest of its phenomena were intermittent and subordinate to ticking! For all this, it is certain [112] that kitchen clocks are not contrived for the purpose of making a ticking noise.

Thus the teleological theorist would be as wrong as the mechanical theorist, among our death-watches;

and, probably, the only death-watch who would be right would be the one who should maintain that the sole thing death-watches could be sure about was the nature of the clock-works and the way they move; and that the purpose of the clock lay wholly beyond the purview of beetle faculties.

Substitute "cosmic vapour" for "clock," and "molecules" for "works," and the application of the argument is obvious. The teleological and the mechanical views of nature are not, necessarily, mutually exclusive. On the contrary, the more purely a mechanist the speculator is, the more firmly does he assume a primordial molecular arrangement, of which all the phenomena of the universe are the consequences; and the more completely is he thereby at the mercy of the teleologist, who can always defy him to disprove that this primordial molecular arrangement was not intended to evolve the phenomena of the universe. On the other hand, if the teleologist assert that this, that, or the other result of the working of any part of the mechanism of the universe is its purpose and final cause, the mechanist can always inquire how he knows that it is more than an unessential incident [113]–the mere ticking of the clock, which he mistakes for its function. And there seems to be no reply to this inquiry, any more than to the further, not irrational, question, why trouble one's self about matters which are out of reach, when the working of the mechanism itself, which is of infinite practical importance, affords scope for all our energies?

Professor Haeckel has invented a new and convenient name "Dysteleology," for the study of the "purposelessnesses" which are observable in living organisms–such as the multitudinous cases of rudimentary and apparently useless structures. I confess, however, that it has often appeared to me that the facts of Dysteleology cut two ways. If we are to assume, as evolutionists in general do, that useless organs atrophy, such cases as the existence of lateral rudiments of toes, in the foot of a horse, place us in a dilemma. For, either these rudiments are of no use to the animal, in which case, considering that the horse has existed in its present form since the Pliocene epoch, they surely ought to have disappeared; or they are of some use to the animal, in which case they are of no use as arguments against Teleology. A similar; but still stronger, argument may be based upon the existence of teats, and even functional mammary glands, in male mammals. Numerous cases of "Gynæcomasty," or functionally active breasts in men, are on record, though there is no mam[114]malian species whatever in which the male normally suckles the young. Thus, there can be little doubt that the mammary gland was as apparently useless in the remotest male mammalian ancestor of man as in living men, and yet it has not disappeared. Is it then still profitable to the male organism to retain it? Possibly; but in that case its dysteleological value is gone.[2]

II. Professor Haeckel looks upon the causes which have led to the present diversity of living nature as twofold. Living matter, he tells us, is urged by two impulses: a centripetal, which tends to preserve and transmit the specific form, and which he identifies with heredity; and a centrifugal, which results from the tendency of external conditions to modify the organism and effect its adaptation to themselves. The internal impulse is conservative, and tends to the preservation of specific, or individual, form; the external impulse is metamorphic, and tends to the modification of specific, or individual, form.

In developing his views upon this subject, Professor Haeckel introduces qualifications which disarm

some of the criticisms I should have been disposed to offer; but I think that his method of stating the case has the inconvenience of tending to leave out of sight the important fact–which is a cardinal point in the Darwinian hypothesis–[115] that the tendency to vary, in a given organism, may have nothing to do with the external conditions to which that individual organism is exposed, but may depend wholly upon internal conditions. No one, I imagine, would dream of seeking for the cause of the development of the sixth finger and toe in the famous Maltese, in the direct influence of the external conditions of his life.

I conceive that both hereditary transmission and adaptation need to be analysed into their constituent conditions by the further application of the doctrine of the Struggle for Existence. It is a probable hypothesis, that what the world is to organisms in general, each organism is to the molecules of which it is composed. Multitudes of these, having diverse tendencies, are competing with one another for opportunity to exist and multiply; and the organism, as a whole, is as much the product of the molecules which are victorious as the Fauna, or Flora, of a country is the product of the victorious organic beings in it.

On this hypothesis, hereditary transmission is the result of the victory of particular molecules contained in the impregnated germ. Adaptation to conditions is the result of the favouring of the multiplication of those molecules whose organising tendencies are most in harmony with such conditions. In this view of the matter, conditions are not actively productive, but are passively permissive; they do not cause variation in any [116] given direction, but they permit and favour a tendency in that direction which already exists.

It is true that, in the long run, the origin of the organic molecules themselves, and of their tendencies, is to be sought in the external world; but if we carry our inquiries as far back as this, the distinction between internal and external impulses vanishes. On the other hand, if we confine ourselves to the consideration of a single organism, I think it must be admitted that the existence of an internal metamorphic tendency must be as distinctly recognised as that of an internal conservative tendency; and that the influence of conditions is mainly, if not wholly, the result of the extent to which they favour the one, or the other, of these tendencies.

III. There is only one point upon which I fundamentally and entirely disagree with Professor Haeckel, but that is the very important one of his conception of geological time, and of the meaning of the stratified rocks as records and indications of that time. Conceiving that the stratified rocks of an epoch indicate a period of depression, and that the intervals between the epochs correspond with periods of elevation of which we have no record, he intercalates between the different epochs, or periods, intervals which he terms "Ante-periods." Thus, instead of considering the Triassic, Jurassic, Cretaceous, and Eocene periods, as continuously successive, he [117] interposes a period before each, as an "Antetrias-zeit," "Antejura-zeit," "Antecreta-zeit," "Anteo-cenzeit," &c. And he conceives that the abrupt changes between the Faunæ of the different formations are due to the lapse of time, of which we have no organic record, during their "Ante-periods."

The frequent occurrence of strata containing assemblages of organic forms which are intermediate between those of adjacent formations, is, to my mind, fatal to this view. In the well-known St. Cassian beds, for example, Palæozoic and Mesozoic forms are commingled, and, between the Cretaceous and the Eocene formations, there are similar transitional beds. On the other hand, in the middle of the Silurian series, extensive unconformity of the strata indicates the lapse of vast intervals of time between the deposit of successive beds, without any corresponding change in the Fauna.

Professor Haeckel will, I fear, think me unreasonable, if I say that he seems to be still overshadowed by geological superstitions; and that he will have to believe in the completeness of the geological record far less than he does at present. He assumes, for example, that there was no dry land, nor any terrestrial life, before the end of the Silurian epoch, simply because, up to the present time, no indications of fresh water, or terrestrial organisms, have been found in rocks of older date. And, in speculating upon the origin of a given group, he [118] rarely goes further back than the "Ante-period," which precedes that in which the remains of animals belonging to that group are found. Thus, as fossil remains of the majority of the groups of *Reptilia* are first found in the Trias, they are assumed to have originated in the "Antetriassic" period, or between the Permian and Triassic epochs.

I confess this is wholly incredible to me. The Permian and the Triassic deposits pass completely into one another; there is no sort of discontinuity answering to an unrecorded "Antetrias"; and, what is more, we have evidence of immensely extensive dry land during the formation of these deposits. We know that the dry land of the Trias absolutely teemed with reptiles of all groups except Pterodactyles, Snakes, and perhaps Tortoises; there is every probability that true Birds existed, and *Mammalia* certainly did. Of the inhabitants of the Permian dry land, on the contrary, all that have left a record are a few lizards. Is it conceivable that these last should really represent the whole terrestrial population of that time, and that the development of Mammals, of Birds, and of the highest forms of Reptiles, should have been crowded into the time during which the Permian conditions quietly passed away, and the Triassic conditions began? Does not any such supposition become in the highest degree improbable, when, in the terrestrial or fresh-water Labyrinthodonts, [119] which lived on the land of the Carboniferous epoch, as well as on that of the Trias, we have evidence that one form of terrestrial life persisted, throughout all these ages, with no important modification? For my part, having regard to the small amount of modification (except in the way of extinction) which the Crocodilian, Lacertilian, and Chelonian *Reptilia* have undergone, from the older Mesozoic times to the present day, I cannot but put the existence of the common stock from which they sprang far back in the Palæozoic epoch; and I should apply a similar argumentation to all other groups of animals.

[The remainder of this essay contains a discussion of questions of taxonomy and phylogeny, which is now antiquated. I have reprinted the considerations about the reconciliation of Teleology with Morphology, about "Dysteleology," and about the struggle for existence within the organism, because it has happened to me to be charged with overlooking them.

In discussing Teleology, I ought to have pointed out, as I have done elsewhere (*Life and Letters of Charles Darwin*, vol.ii, p. 202), that Paley "proleptically accepted the modern doctrine of Evolution," (*Natural Theology*, chap. xxiii.). 1893.]

[1] *The Natural History of Creation.* By Dr. Ernst Haeckel. *[Natürliche Schöpfungs-Geschichte.*–Von Dr. Ernst Haeckel, Professor an der Universität Jena.] Berlin, 1868.

[2] [The recent discovery of the important part played by the Thyroid gland should be a warning to all speculators about useless organs. 1893.]

THE HUXLEY FILE

Preface and Table of Contents to Volume II, *Darwiniana*, of Huxley's *Collected Essays.*

Next article: Mr. Darwin's Critics [1871], pages 120-186.

Previous article: Criticisms on "The Origin of Species" [1864], pages 80-106.

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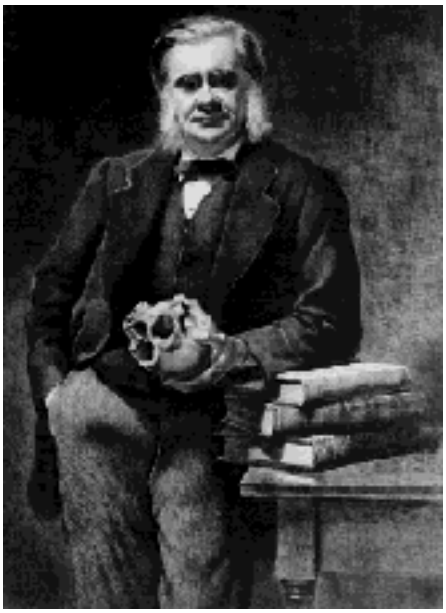

Mr. Darwin's Critics[1] (1871)

Collected Essays II

[120] The gradual lapse of time has now separated us by more than a decade from the date of the publication of the "Origin of Species"–and whatever may be thought or said about Mr. Darwin's doctrines, or the manner in which he has propounded them, this much is certain, that, in a dozen years, the "Origin of Species" has worked as complete a revolution in biological science as the "Principia" did in astronomy–and it has done so, because, in the words of Helmholtz, it contains "an essentially new creative thought."[2]

And as time has slipped by, a happy change [121] has come over Mr. Darwin's critics. The mixture of ignorance and insolence which, at first, characterised a large proportion of the attacks with which he was assailed, is no longer the sad distinction of anti-Darwinian criticism. Instead of abusive nonsense, which merely discredited its writers, we read essays, which are, at worst, more or less intelligent and appreciative; while, sometimes, like that which appeared in the "North British Review" for 1867, they have a real and permanent value.

The several publications of Mr. Wallace and Mr. Mivart contain discussions of some of Mr. Darwin's views, which are worthy of particular attention, not only on account of the acknowledged scientific competence of these writers, but because they exhibit an attention to those philosophical questions which underlie all physical science, which is as rare as it is needful. And the same may be said of an article in the "Quarterly Review" for July 1871, the comparison of which with an article in the same Review for July 1860, is perhaps the best evidence which can be brought forward of the change which has taken place in public opinion on "Darwinism."

The Quarterly Reviewer admits "the certainty of the action of natural selection" (p. 49); and further allows that there is an *a priori* probability in favour of the evolution of man from some lower animal form, if these lower animal forms themselves have arisen by evolution.

[122] Mr. Wallace and Mr. Mivart go much further than this. They are as stout believers in evolution as Mr. Darwin himself; but Mr. Wallace denies that man can have been evolved from a lower animal by that process of natural selection which he, with Mr. Darwin, holds to have been sufficient for the evolution of all animals below man; while Mr. Mivart, admitting that natural selection has been one of the conditions of the evolution of the animals below man, maintains that natural selection must, even in their case, have been supplemented by "some other cause"–of the nature of which, unfortunately, he does not give us any idea. Thus Mr. Mivart is less of a Darwinian than Mr. Wallace, for he has less faith in the power of natural selection. But he is more of an evolutionist than Mr. Wallace, because Mr. Wallace thinks it necessary to call in an intelligent agent–a sort of supernatural Sir John Sebright–to produce even the animal frame of man; while Mr. Mivart requires no Divine assistance till he comes to

man's soul.

Thus there is a considerable divergence between Mr. Wallace and Mr. Mivart. On the other hand, there are some curious similarities between Mr. Mivart and the Quarterly Reviewer, and these are sometimes so close, that, if Mr. Mivart thought it worth while, I think he might make out a good case of plagiarism against the Reviewer, who studiously abstains from quoting him.

[123] Both the Reviewer and Mr. Mivart reproach Mr. Darwin with being, "like so many other physicists," entangled in a radically false metaphysical system, and with setting at nought the first principles of both philosophy and religion. Both enlarge upon the necessity of a sound philosophical basis, and both, I venture to add, make a conspicuous exhibition of its absence. The Quarterly Reviewer believes that man "differs more from an elephant or a gorilla than do these from the dust of the earth on which they tread," and Mr. Mivart has expressed the opinion that there is more difference between man and an ape than there is between an ape and a piece of granite.[3]

And even when Mr. Mivart (p. 86) trips in a matter of anatomy, and creates a difficulty for Mr. Darwin out of a supposed close similarity between the eyes of fishes and cephalopods, which (as Gegenbaur and others have clearly shown) does not exist, the Quarterly Reviewer adopts the argument without hesitation (p. 66).

There is another important point, however, in which it is hard to say whether Mr. Mivart diverges from the Quarterly Reviewer or not.

The Reviewer declares that Mr. Darwin has, "with needless opposition, set at nought the first principles of both philosophy and religion" (p. 90).

[124] It looks, at first, as if this meant, that Mr. Darwin's views being false, the opposition to "religion" which flows from them must be needless. But I suspect this is not the right view of the meaning of the passage, as Mr. Mivart, from whom the Quarterly Reviewer plainly draws so much inspiration, tells us that "the consequences which have been drawn from evolution, whether exclusively Darwinian or not, to the prejudice of religion, by no means follow from it, and are in fact illegitimate" (p. 5).

I may assume, then, that the Quarterly Reviewer and Mr. Mivart admit that there is no necessary opposition between "evolution whether exclusively Darwinian or not," and religion. But then, what do they mean by this last much abused term? On this point the Quarterly Reviewer is silent. Mr. Mivart, on the contrary, is perfectly explicit, and the whole tenor of his remarks leaves no doubt that by "religion" he means theology; and by theology, that particular variety of the great Proteus, which is expounded by the doctors of the Roman Catholic Church, and held by the members of that religious community to be the sole form of absolute truth and of saving faith.

According to Mr. Mivart, the greatest and most orthodox authorities upon matters of Catholic doctrine agree in distinctly asserting "derivative creation" or evolution; "and thus their teachings [125] harmonise

with all that modern science can possibly require" (p. 305).

I confess that this bold assertion interested me more than anything else in Mr. Mivart's book. What little knowledge I possessed of Catholic doctrine, and of the influence exerted by Catholic authority in former times, had not led me to expect that modern science was likely to find a warm welcome within the pale of the greatest and most consistent of theological organisations.

And my astonishment reached its climax when I found Mr. Mivart citing Father Suarez as his chief witness in favour of the scientific freedom enjoyed by Catholics–the popular repute of that learned theologian and subtle casuist not being such as to make his works a likely place of refuge for liberality of thought. But in these days, when Judas Iscariot and Robespierre, Henry VIII. and Catiline, have all been shown to be men of admirable virtue, far in advance of their age, and consequently the victims of vulgar prejudice, it was obviously possible that Jesuit Suarez might be in like case. And, spurred by Mr. Mivart's unhesitating declaration, I hastened to acquaint myself with such of the works of the great Catholic divine as bore upon the question, hoping, not merely to acquaint myself with the true teachings of the infallible Church, and free myself of an unjust prejudice; but, haply, to enable myself, at a pinch, to put some Protestant bibliolater to [126] shame, by the bright example of Catholic freedom from the trammels of verbal inspiration.

I regret to say that my anticipations have been cruelly disappointed. But the extent to which my hopes have been crushed can only be fully appreciated by citing, in the first place, those passages of Mr. Mivart's work by which they were excited. In his introductory chapter I find the following passages:–

"The prevalence of this theory [of evolution] need alarm no one, for it is, without any doubt, perfectly consistent with the strictest and most orthodox Christian[4] theology" (p. 5).

"Mr. Darwin and others may perhaps be excused if they have not devoted much time to the study of Christian philosophy; but they have no right to assume or accept without careful examination, as an unquestioned fact, that in that philosophy there is a necessary antagonism between the two ideas 'creation' and 'evolution,' as applied to organic forms.

"It is notorious and patent to all who choose to seek, that many distinguished Christian thinkers have accepted, and do accept, both ideas, *i.e.* both 'creation' and 'evolution.'

"As much as ten years ago an eminently Christian writer observed: 'The creationist theory does not necessitate the perpetual search after [127] manifestations of miraculous power and perpetual "catastrophes." Creation is not a miraculous interference with the laws of Nature, but the very institution of those laws. Law and regularity, not arbitrary intervention, was the patristic ideal of creation. With this notion they admitted, without difficulty, the most surprising origin of living creatures, provided it took place by *law*. They held that when God said, "Let the waters produce," "Let the earth produce," He conferred forces on the elements of earth and water which enabled them naturally to produce the various species of organic beings. This power, they thought, remains attached to the elements throughout all

time.' The same writer quotes St. Augustin and St. Thomas Aquinas, to the effect that, 'in the institution of Nature, we do not look for miracles, but for the laws of Nature.' And, again, St. Basil speaks of the continued operation of natural laws in the production of all organisms.

"So much for the writers of early and mediæval times. As to the present day, the author can confidently affirm that there are many as well versed in theology as Mr. Darwin is in his own department of natural knowledge, who would not be disturbed by the thorough demonstration of his theory. Nay, they would not even be in the least painfully affected at witnessing the generation of animals of complex organisation by the skilful [128] artificial arrangement of natural forces, and the production, in the future, of a fish by means analogous to those by which we now produce urea.

"And this because they know that the possibility of such phenomena, though by no means actually foreseen, has yet been fully provided for in the old philosophy centuries before Darwin, or even centuries before Bacon, and that their place in the system can be at once assigned them without even disturbing its order or marring its harmony.

"Moreover, the old tradition in this respect has never been abandoned, however much it may have been ignored or neglected by some modern writers. In proof of this, it may be observed that perhaps no post-mediæval theologian has a wider reception amongst Christians throughout the world than Suarez, who has a separate section[5] in opposition to those who maintain the distinct creation of the various kinds–or substantial forms–of organic life" (pp. 19–21).

Still more distinctly does Mr. Mivart express himself in the same sense, in his last chapter, entitled "Theology and Evolution" (pp. 302-5).

"It appears, then, that Christian thinkers are perfectly free to accept the general evolution theory. But are there any theological authorities to justify this view of the matter?

[129] "Now, considering how extremely recent are these biological speculations, it might hardly be expected *a priori* that writers of earlier ages should have given expression to doctrines harmonising in any degree with such very modern views; nevertheless, this is certainly the case, and it would be easy to give numerous examples. It will be better, however, to cite one or two authorities of weight. Perhaps no writer of the earlier Christian ages could be quoted whose authority is more generally recognised than that of St. Augustin. The same may be said of the mediæval period for St. Thomas Aquinas: and since the movement of Luther, Suarez may be taken as an authority, widely venerated, and one whose orthodoxy has never been questioned.

"It must be borne in mind that for a considerable time even after the last of these writers no one had disputed the generally received belief as to the small age of the world, or at least of the kinds of animals and plants inhabiting it. It becomes, therefore, much more striking if views formed under such a condition of opinion are found to harmonise with modern ideas concerning 'Creation' and organic Life.

"Now St. Augustin insists in a very remarkable manner on the merely derivative sense in which God's creation of organic forms is to be understood; that is, that God created them by conferring [130] on the material world the power to evolve them under suitable conditions."

Mr. Mivart then cites certain passages from St. Augustin, St. Thomas Aquinas, and Cornelius à Lapide, and finally adds:–

"As to Suarez, it will be enough to refer to Disp. xv. sec. 2, No. 9, p. 508, t. i. edition Vivés, Paris; also Nos. 13-15. Many other references to the same effect could easily be given, but these may suffice.

"It is then evident that ancient and most venerable theological authorities distinctly assert *derivative* creation, and thus their teachings harmonise with all that modern science can possibly require."

It will be observed that Mr. Mivart refers solely to Suarez's fifteenth Disputation, though he adds, "Many other references to the same effect could easily be given." I shall look anxiously for these references in the third edition of the "Genesis of Species." For the present, all I can say is, that I have sought in vain, either in the fifteenth Disputation, or elsewhere, for any passage in Suarez's writings which, in the slightest degree, bears out Mr. Mivart's views as to his opinions.[6]

The title of this fifteenth Disputation is "De causa formali substantiali," and the second section of that Disputation (to which Mr. Mivart refers) is headed, "Quomodo possit forma substantialis fieri in materia et ex materia?"

[131] The problem which Suarez discusses in this place may be popularly stated thus: According to the scholastic philosophy every natural body has two components–the one its "matter" (*materia prima*), the other its "substantial form" (*forma substantialis*). Of these the matter is everywhere the same, the matter of one body being indistinguishable from the matter of any other body. That which differentiates any one natural body from all others is its substantial form, which inheres in the matter of that body, as the human soul inheres in the matter of the frame of man, and is the source of all the activities and other properties of the body.

Thus, says Suarez, if water is heated, and the source of heat is then removed, it cools again. The reason of this is that there is a certain "*intimius principium*" in the water, which brings it back to the cool condition when the external impediment to the existence of that condition is removed. This *intimius principium* is the "substantial form" of the water. And the substantial form of the water is not only the cause (*radix*) of the coolness of the water, but also of its moisture, of its density, and of all its other properties.

It will thus be seen that "substantial forms" play nearly the same part in the scholastic philosophy as "forces" do in modern science; the general tendency of modern thought being to conceive all bodies as resolvable into material [132] particles and forces, in virtue of which last these particles assume those dispositions and exercise those powers which are characteristic of each particular kind of matter.

But the Schoolmen distinguished two kinds of substantial forms, the one spiritual and the other material. The former division is represented by the human soul, the *anima rationalis;* and they affirm as a matter, not merely of reason, but of faith, that every human soul is created out of nothing, and by this act of creation is endowed with the power of existing for all eternity, apart from the *materia prima* of which the corporeal frame of man is composed. And the *anima rationalis,* once united with the *materia prima* of the body, becomes its substantial form, and is the source of all the powers and faculties of man–of all the vital and sensitive phenomena which he exhibits–just as the substantial form of water is the source of all its qualities.

The "material substantial forms" are those which inform all other natural bodies except that of man; and the object of Suarez in the present Disputation, is to show that the axiom "*ex nihilo nihil fit,*" though not true of the substantial form of man, is true of the substantial forms of all other bodies, the endless mutations of which constitute the ordinary course of nature. The origin of the difficulty which he discusses is easily comprehensible. Suppose a piece of bright iron [133] to be exposed to the air. The existence of the iron depends on the presence within it of a substantial form, which is the cause of its properties, *e.g.* brightness, hardness, weight. But, by degrees, the iron becomes converted into a mass of rust, which is dull, and soft, and light, and, in all other respects, is quite different from the iron. As, in the scholastic view, this difference is due to the rust being informed by a new substantial form, the grave problem arises, how did this new substantial form come into being? Has it been created? or has it arisen by the power of natural causation? If the former hypothesis is correct, then the axiom, "*ex nihilo nihil fit,*" is false, even in relation to the ordinary course of nature, seeing that such mutations of matter as imply the continual origin of new substantial forms are occurring every moment. But the harmonisation of Aristotle with theology was as dear to the Schoolmen, as the smoothing down the differences between Moses and science is to our Broad Churchmen, and they were proportionably unwilling to contradict one of Aristotle's fundamental propositions. Nor was their objection to flying in the face of the Stagirite likely to be lessened by the fact that such flight landed them in flat Pantheism.

So Father Suarez fights stoutly for the second hypothesis; and I quote the principal part of his argumentation as an exquisite specimen of that speech which is a "darkening of counsel."

[134] "13. Secundo de omnibus aliis formis substantialibus [sc. materialibus] dicendum est non fieri proprie ex nihilo, sed ex potentia præjacentis materiæ educi: ideoque in effectione harum formarum nil fieri contra illud axioma, *Ex nihilo nihil fit,* si recte intelligatur: Hæc assertio sumitur ex Aristotele 1. Physicorum per totum et libro 7. Metaphyss. et ex aliis auctoribus, quos statim referam. Et declaratur breviter, nam fieri ex nihilo duo dicit, unum est fieri absolute et simpliciter, aliud est quod talis effectio fit ex nihilo. Primum propriè dicitur de re subsistente, quia ejus est fieri, cujus est esse: id autem proprie quod subsistit et habet esse; nam quod alteri adjacet, potius est quo aliud est. Ex hac ergo parte, formæ substantiales materiales non fiunt ex nihilo, quia proprie non fiunt. Atque hanc rationem reddit Divus Thomas 1 parte, quæstione 45, articulo 8, et quæstione 90, articulo 2, et ex dicendis magis explicabitur. Sumendo ergo ipsum *fieri* in hac proprietate et rigore, sic fieri ex nihilo est fieri secundum se totum, id est nulla sui parte præsupposita, ex quo fiat. Et hac ratione res naturales dum de novo fiunt, non fiunt ex nihilo, quia fiunt ex præsupposita materia, ex qua componuntur, et ita non fiunt, secundum se totee, sed secundum aliquid sui. Formæ autem harum rerum, quamvis revera totam suam entitatem de novo accipiant, quam antea non habebant, quia vero ipsæ non fiunt, ut dictum est, ideo neque ex nihilo fiunt.

Attamen, quia latiori modo sumendo verbum illud *fieri* negari non potest: quin forma facta sit, eo modo quo nunc est, et antea non crat, ut etiam probat ratio dubitandi posita in principio sectionis, ideo addendum est, sumpto *fieri* in hac amplitudine, fieri ex nihilo non tamen negare habitudinem materialis causa intrinsecè componentis id quod fit, sed etiam habitudinem causæ materialis per se causantis et sustentantis formam quæ fit, seu confit. Diximus enim in superioribus materiam et esse causam compositi et formæ dependentis ab illa: ut res ergo dicatur ex nihilo fieri uterque modus causalitatis negari debet; et eodem sensu accipiendum est illud axioma, ut sit verum: *Ex nihilo nihil fit*, scilicet virtute agentis naturalis et finiti nihil fieri, nisi ex præsupposito subjecto per se concurrente, ct ad compositum et ad formam, si utrumque suo modo ab eodem agente fiat. Ex his ergo rectè [135] concluditur, formas substantiales materiales non fieri ex nihilo, quia fiunt ex materia, quæ in suo genere per se concurrit, et influit ad esse, et fieri talium formarum; quia, sicut esse non possunt nisi affixæ materiæ, a qua substententur in esse: ita nec fieri possunt, nisi earum effectio et penetratio in eadem materia effectionem ex nihilo, et ex aliquo, propter quam, ut infra ostendemus, prior modus efficiendi superat vim finitam naturaliam agentiu, non vero posterior.

"14. Ex his etiam constat, proprie de his formis dici non creari, sed educi de potentia materiæ."[7]

If I may venture to interpret these hard sayings, Suarez conceives that the evolution of substantial forms in the ordinary course of nature, is conditioned not only by the existence of the *materia prima*, but also by a certain "concurrence and influence" which that *materia* exerts; and every new substantial form being thus conditioned, and in part, at any rate, caused, by a pre-existing something, cannot be said to be created out of nothing.

But as the whole tenor of the context shows, Suarez applies this argumentation merely to the evolution of material substantial forms in the ordinary course of nature. How the substantial forms of animals and plants primarily originated, is a question to which, so far as I am able to discover, he does not so much as allude in his "Metaphysical Disputations." Nor was there any necessity that he should do so, inasmuch as he [136] has devoted a separate treatise of considerable bulk to the discussion of all the problems which arise out of the account of the Creation which is given in the Book of Genesis. And it is a matter of wonderment to me that Mr. Mivart, who somewhat sharply reproves "Mr. Darwin and others" for not acquainting themselves with the true teachings of his Church, should allow himself to be indebted to a heretic like myself for a knowledge of the existence of that "Tractatus de opere sex Dierum,"[8] in which the learned Father, of whom he justly speaks, as "an authority widely venerated, and whose orthodoxy has never been questioned," directly opposes all those opinions for which Mr. Mivart claims the shelter of his authority.

In the tenth and eleventh chapters of the first book of this treatise, Suarez inquires in what sense the word "day," as employed in the first chapter of Genesis, is to be taken. He discusses the views of Philo and of Augustin on this question, and rejects them. He suggests that the approval of their allegorising interpretations by St. Thomas Aquinas, merely arose out of St. Thomas's modesty, and his desire not to seem openly to controvert St. Augustin–"voluisse Divus Thomas pro sua modestia subterfugere vim argumenti potius quam aperte Augustinum inconstantiæ arguere."

Finally, Suarez decides that the writer of Genesis meant that the term "day" should be taken in its natural

sense; and he winds up the discussion with the very just and natural remark that "it is not probable that God, in inspiring Moses to write a history of the Creation which was to be believed by ordinary people, would have made him use language, the true meaning of which it is hard to discover, and still harder to believe."[9]

And in chapter xii. 3, Suarez further observes:–

"Ratio enim retinendi veram significationem diei naturalis est illa communis, quod verba Scripturæ non sunt ad metaphoras transferenda, nisi vel necessitas cogit, vel ex ipsa scriptura constet, et maximè in historica narratione et ad instructionem fidei pertinente: sed hæc ratio non minus cogit ad intelligendum propriè dierum numerum, quam diei qualitatem, QUIA NON MINUS UNO MODO QUAM ALIO DESTRUITUR SINCERITAS, IMO ET VERITAS HISTORIÆ. Secundo hoc valde confirmant alia Scripturæ loca, in quibus hi sex dies tanquam veri, et inter se distincti commemorantur, ut Exod. 20 dicitur, *Sex diebus operabis et facies omnia opera tua,septimo autem die Sabbatum Domini Die* [138] *tui est.* Et infra: *Sex enim diebus fecit Dominus cælum et terram et mare et omnia quæ in eis sunt,* et idem repetitur in cap. 31. In quibus locis sermonis proprietas colligi potest tum ex æquiparatione, nam cum dicitur: *sex diebus operabis,* propriissimè intelliquitur: tum quia non est verisimile, potuisse populum intelligere verba illa in alio sensu, et è contrario incredibile est, Deum in suis præceptis tradendis illis verbis ad populum fuisse loquutum, quibus deciperetur, falsum sensum concipiendo, si Deus non per sex veros dies opera sua fecisset."

These passages leave no doubt that this great doctor of the Catholic Church, of unchallenged authority and unspotted orthodoxy, not only declares it to be Catholic doctrine that the work of creation took place in the space of six natural days; but that he warmly repudiates, as inconsistent with our knowledge of the Divine attributes, the supposition that the language which Catholic faith requires the believer to hold that God inspired, was used in any other sense than that which He knew it would convey to the minds of those to whom it was addressed.

And I think that in this repudiation Father Suarez will have the sympathy of every man of common uprightness, to whom it is certainly "incredible" that the Almighty should have acted in a manner which He would esteem dishonest and base in a man.

But the belief that the universe was created in six natural days is hopelessly inconsistent with the doctrine of evolution, in so far as it applies to the stars and planetary bodies; and it can be [139] made to agree with a belief in the evolution of living beings only by the supposition that the plants and animals, which are said to have been created on the third, fifth, and sixth days, were merely the primordial forms, or rudiments, out of which existing plants and animals have been evolved; so that, on these days, plants and animals were not created actually, but only potentially.

The latter view is that held by Mr. Mivart, who follows St. Augustin, and implies that he has the sanction of Suarez. But, in point of fact, the latter great light of orthodoxy takes no small pains to give the most explicit and direct contradiction to all such imaginations, as the following passages prove. In the first place, as regards plants, Suarez discusses the problem:–

"*Quomodo herba virens et cætera vegetabilia hoc [tertio] die fuerint producta.*[10]

"Præcipua enim difficultas hîc est, quam attingit Div. Thomas 1, par. qu. 69, art. 2, an hæc productio plantarum hoc die facta intelligenda sit de productione ipsarum in proprio esse actuali et formali (ut sic rem explicerem) vel de productione tantum in semine et in potentia. Nam Divus Augustinus libro quinto Genes. ad liter. cap. 4 et 5 et libro 8, cap. 3, posteriorem partem tradit, dicens, terram in hoc die accepisse virtutem germinandi omnia vegetabilia quasi concepto omnium illorum semine, non tamen statim vegetabilia omnia produxisse. Quod primo suadet verbis illis capitis secundi. *In die quo facit Deus cœlum et terram et* [140] *omne virgultum agri priusquam germinaret.* Quomodo enim potuerunt virgulta fieri antequam terra germinaret nisi quia causaliter prius et quasi in radice, seu in semine facta sunt, et postea in actu producta? Secundo confirmari potest, quia verbum illud *germinet terra* optimè exponitur potestativè ut sic dicam, id est accipiat terra vim germinandi. Sicut in eodem capite dicitur *crescite et multiplicamini.* Tertio potest confirmari, quia actualis productio vegetabilium non tam ad opus creationis, quam ad opus propagationis pertinet, quod postea factum est. Et hanc sententiam sequitur Eucherius lib. 1, in Gen. cap. 11, et illi faveat Glossa, interli. Hugo. et Lyran. dum verbum *germinet* dicto modo exponunt. Nihilominus contraria sententia tennenda est: Scillicet, produxisse Deum hoc die herbam, arbores, et alia vegetabilia actu inpropria specie et natura. Hæc est communis sententia Patrum.–Basil. homil. 5; Exæmer. Ambros. lib. 3; Exæmer. cap. 8, 11, et 16; Chrysost. homil. 5 in Gen. Damascene. lib. 2 de Fid. cap. 10; Theodor. Cyrilli. Bedæ, Glossæ ordinariæ et aliorum in Gen. Et idem sentit Divus Thomas, *supra,* solvens argumenta Augustini, quamvis propter reverentiam ejus quasi problematicè semper procedat. Denique idem sentiunt omnes qui in his operibus veram successionem et temporalem distinctionem agnoseant."

Secondly, with respect to animals, Suarez is no less decided:–

"De animalium ratione carentium productione quinto et sexto die facta.[11]

"32. Primo ergo nobis certum sit hæc animantia non in virtute tantum aut in semine, sed actu, et in seipsis, facta fuisse his diebus in quibus facta narrantur. Quanquam Augustinus lib. 3, Gen. ad liter. cap. 5 in sua persistens sententia contrarium sentire videatur."

But Suarez proceeds to refute Augustin's [141] opinions at great length, and his final judgment may be gathered from the following passage:–

"35. Tertio dicendum est, hæc animalia omnia his diebus producta esse, in perfecto statu, in singulis individuis, seu speciebus suis, juxta uniuscujusque naturam ... Itaque fuerunt omnia creata integra et omnibus suis membris perfecta."

As regards the creation of animals and plants, therefore, it is clear that Suarez, so far from "distinctly asserting derivative creating," denies it as distinctly and positively as he can; that he is at much pains to refute St. Augustin's opinions; that he does not hesitate to regard the faint acquiescence of St. Thomas Aquinas in the views of his brother saint as a kindly subterfuge on the part of Divus Thomas; and that he affirms his own view to be that which is supported by the authority of the Fathers of the Church. So that, when Mr. Mivart tells us that Catholic theology is in harmony with all that modern science can possibly require; that "to the general theory of evolution, and to the special Darwinian form of it, no exception . . . need be taken on the ground of orthodoxy;" and that "law and regularity, not arbitrary

intervention, was the Patristic ideal of creation," we have to choose between his dictum, as a theologian, and that of a great light of his Church, whom he himself declares to be "widely venerated as an [142] authority, and whose orthodoxy has never been questioned."

But Mr. Mivart does not hesitate to push his attempt to harmonise science with Catholic orthodoxy to its utmost limit; and, while assuming that the soul of man "arises from immediate and direct creation," he supposes that his body was "formed at first (as now in each separate individual) by derivative, or secondary creation, through natural laws" (p. 331).

This means, I presume, that an animal, having the corporeal form and bodily powers of man, may have been developed out of some lower form of life by a process of evolution; and that, after this anthropoid animal had existed for a longer or shorter time, God made a soul by direct creation, and put it into the manlike body, which, heretofore, had been devoid of that *anima rationalis,* which is supposed to be man's distinctive character.

This hypothesis is incapable of either proof or disproof, and therefore may be true; but if Suarez is any authority, it is not Catholic doctrine. "Nulla est in homine forma educta de potentia materiæ,"[12] is a dictum which is absolutely inconsistent with the doctrine of the natural evolution of any vital manifestation of the human body.

Moreover, if man existed as an animal before [143] he was provided with a rational soul, he must, in accordance with the elementary requirements of the philosophy in which Mr. Mivart delights, have possessed a distinct sensitive and vegetative soul, or souls. Hence, when the "breath of life" was breathed into the manlike animal's nostrils, he must have already been a living and feeling creature. But Suarez particularly discusses this point, and not only rejects Mr. Mivart's view, but adopts language of very theological strength regarding it.

"Possent præterea his adjungi argumenta theologica, ut est illud quod sumitur ex illis verbis Genes. 2. *Formavit Deus hominem ex limo terræ et inspiravit in faciem ejus spiraculum vitæ et factus est homo in animam viventem:* ille enim spiritus, quam Deus spiravit, anima rationalis fuit, et per eadem factus est homo vivens, et consequenter, etiam sentiens.

"Aliud est ex VIII. Synodo Generali quæ est Constantinopolitana IV. can. 11, qui sic habet. *Apparet quosdam in tantum impietatis venisse ut homines duas animas habere dogmatizent: talis igitur impictatis inventores et similes sapientes, cum Vetus et Novum Testamentum omnesque Ecclesiæ patres unam animam rationalem hominem habere asseverent, Sancta et universalis Synodus anathematizat.*"[13]

Moreover, if the animal nature of man was the result of evolution, so must that of woman have been. But the Catholic doctrine, according to Suarez, is that woman was, in the strictest and most literal sense of the words, made out of the rib of man.

[144] "Nihilominus sententia Catholica est, verba illa Scripturæ esse ad literam intelligenda. Ac proinde vere, ac

realiter, tulisse Deum Costam Adamæ, et, ex illa, corpus Evæ formasse."[14]

Nor is there any escape in the supposition that some woman existed before Eve, after the fashion of the Lilith of the rabbis; since Suarez qualifies that notion, along with some other Judaic imaginations, as simply "damnabilis."[15]

After the perusal of the "Tractatus de Opere" it is, in fact, impossible to admit that Suarez held any opinion respecting the origin of species, except such as is consistent with the strictest and most literal interpretation of the words of Genesis. For Suarez, it is Catholic doctrine, that the world was made in six natural days. On the first of these days the *materia prima* was made out of nothing, to receive afterwards those "substantial forms" which moulded it into the universe of things; on the third day, the ancestors of all living plants suddenly came into being, full-grown, perfect, and possessed of all the properties which now distinguish them; while, on the fifth and sixth days, the ancestors of all existing animals were similarly caused to exist in their complete and perfect state, by the infusion of their appropriate material substantial forms into the matter [145] which had already been created. Finally, on the sixth day, the *anima rationalis*–that rational and immortal substantial form which is peculiar to man–was created out of nothing, and "breathed into" a mass of matter which, till then, was mere dust of the earth, and so man arose. But the species man was represented by a solitary male individual, until the Creator took out one of his ribs and fashioned it into a female.

This is the view of the "Genesis of Species" held by Suarez to be the only one consistent with Catholic faith: it is because he holds this view to be Catholic that he does not hesitate to declare St. Augustin unsound, and St. Thomas Aquinas guilty of weakness, when the one swerved from this view and the other tolerated the deviation. And, until responsible Catholic authority–say, for example, the Archbishop of Westminster formally declares that Suarez was wrong, and that Catholic priests are free to teach their flocks that the world was *not* made in six natural days, and that plants and animals were *not* created in their perfect and complete state, but have been evolved by natural processes through long ages from certain germs in which they were potentially contained, I, for one, shall feel bound to believe that the doctrines of Suarez are the only ones which are sanctioned by Infallible Authority, as represented by the Holy Father and the Catholic Church.

[146] I need hardly add that they are as absolutely denied and repudiated by Scientific Authority, as represented by Reason and Fact. The question whether the earth and the immediate progenitors of its present living population were made in six natural days or not is no longer one upon which two opinions can be held.

The fact that it did not so come into being stands upon as sound a basis as any fact of history whatever. It is not true that existing plants and animals came into being within three days of the creation of the earth out of nothing, for it is certain that innumerable generations of other plants and animals lived upon the earth before its present population. And when, Sunday after Sunday, men who profess to be our instructors in righteousness read out the statement, "In six days the Lord made heaven and earth, the sea, and all that in them is," in innumerable churches, they are either propagating what they may easily

know, and, therefore, are bound to know, to be falsities; or, if they use the words in some non-natural sense, they fall below the moral standard of the much-abused Jesuit.

Thus far the contradiction between Catholic verity and Scientific verity is complete and absolute, quite independently of the truth or falsehood of the doctrine of evolution. But, for those who hold the doctrine of evolution, all the Catholic verities about the creation of living beings must [147] be no less false. For them, the assertion that the progenitors of all existing plants were made on the third day, of animals on the fifth and sixth days, in the forms they now present, is simply false. Nor can they admit that man was made suddenly out of the dust of the earth; while it would be an insult to ask an evolutionist whether he credits the preposterous fable respecting the fabrication of woman to which Suarez pins his faith. If Suarez has rightly stated Catholic doctrine, then is evolution utter heresy. And such I believe it to be. In addition to the truth of the doctrine of evolution, indeed, one of its greatest merits in my eyes, is the fact that it occupies a position of complete and irreconcilable antagonism to that vigorous and consistent enemy of the highest intellectual, moral, and social life of mankind–the Catholic Church. No doubt, Mr. Mivart, like other putters of new wine into old bottles, is actuated by motives which are worthy of respect, and even of sympathy; but his attempt has met with the fate which the Scripture prophesies for all such.

Catholic theology, like all theologies which are based upon the assumption of the truth of the account of the origin of things given in the Book of Genesis, being utterly irreconcilable with the doctrine of evolution, the student of science, who is satisfied that the evidence upon which the doctrine of evolution rests, is incomparably stronger and [148] better than that upon which the supposed authority of the Book of Genesis rests, will not trouble himself further with these theologies, but will confine his attention to such arguments against the view he holds as are based upon purely scientific data–and by scientific data I do not merely mean the truths of physical, mathematical, or logical science, but those of moral and metaphysical science. For by science I understand all knowledge which rests upon evidence and reasoning of a like character to that which claims our assent to ordinary scientific propositions. And if any one is able to make good the assertion that his theology rests upon valid evidence and sound reasoning, then it appears to me that such theology will take its place as a part of science.

The present antagonism between theology and science does not arise from any assumption by the men of science that all theology must necessarily be excluded from science, but simply because they are unable to allow that reason and morality have two weights and two measures; and that the belief in a proposition, because authority tells you it is true, or because you wish to believe it, which is a high crime and misdemeanour when the subject matter of reasoning is of one kind, becomes under the *alias* of "faith" the greatest of all virtues when the subject matter of reasoning is of another kind.

The Bishop of Brechin said well the other [149] day:–"Liberality in religion–I do not mean tender and generous allowances for the mistakes of others–is only unfaithfulness to truth."[16] And, with the same qualification, I venture to paraphrase the Bishop's dictum: "Ecclesiasticism in science is only unfaithfulness to truth."

Elijah's great question, "Will you serve God or Baal? Choose ye," is uttered audibly enough in the ears of every one of us as we come to manhood. Let every man who tries to answer it seriously ask himself whether he can be satisfied with the Baal of authority, and with all the good things his worshippers are promised in this world and the next. If he can, let him, if he be so inclined, amuse himself with such scientific implements as authority tells him are safe and will not cut his fingers; but let him not imagine he is, or can be, both a true son of the Church and a loyal soldier of science.

And, on the other hand, if the blind acceptance of authority appears to him in its true colours, as mere private judgment *in excelsis*, and if he have the courage to stand alone, face to face with the abyss of the eternal and unknowable, let him be content, [150] to follow once for all, not only to renounce the good things promised by "Infallibility," but even to bear the bad things which it prophesies; content to follow reason and fact in singleness and honesty of purpose, wherever they may lead, in the sure faith that a hell of honest men will, to him, be more endurable than a paradise full of angelic shams.

Mr. Mivart asserts that "without a belief in a personal God there is no religion worthy of the name." This is a matter of opinion. But it may be asserted, with less reason to fear contradiction, that the worship of a personal God, who, on Mr. Mivart's hypothesis, must have used language studiously calculated to deceive His creatures and worshippers, is "no religion worthy of the name." "Incredible est, Deum illis verbis ad populum fuisse locutum quibus deciperetur," is a verdict in which, for once, Jesuit casuistry concurs with the healthy moral sense of all mankind.

Having happily got quit of the theological aspect of evolution, the supporter of that great truth who turns to the scientific objections which are brought against it by recent criticism, finds, to his relief, that the work before him is greatly lightened by the spontaneous retreat of the enemy from nine-tenths of the territory which he occupied ten years ago. Even the Quarterly Reviewer not only abstains from venturing to deny that evolution has taken place, but he openly admits that Mr. Darwin has forced on men's minds "a recognition of the probability, if not more, of [151] evolution, and of the certainty of the action of natural selection" (p. 49).

I do not quite see, myself, how, if the action of natural selection is *certain*, the occurrence of evolution is only *probable;* inasmuch as the development of a new species by natural selection is, so far as it goes, evolution. However, it is not worth while to quarrel with the precise terms of a sentence which shows that the high water mark of intelligence among those most respectable of Britons, the readers of the *Quarterly Review*, has now reached such a level that the next tide may lift them easily and pleasantly on the once-dreaded shore of evolution. Nor, having got there, do they seem likely to stop, until they have reached the inmost heart of that great region, and accepted the ape ancestry of, at any rate, the body of man. For the Reviewer admits that Mr. Darwin can be said to have established:

"That if the various kinds of lower animals have been evolved one from the other by a process of natural generation or evolution, then it becomes highly probable, *a priori*, that man's body has been similarly evolved; but this, in such a case, becomes equally probable from the admitted fact that he is an animal at all" (p. 65).

From the principles laid down in the last sentence it would follow that if man were constructed upon a

plan as different from that of any other animal as that of a sea-urchin is from that of a whale, it would be "equally probable" that he [152] had been developed from some other animal as it is now, when we know that for every bone, muscle, tooth, and even pattern of tooth, in man, there is a corresponding bone, muscle, tooth, and pattern of tooth, in an ape. And this shows one of two things–either that the Quarterly Reviewer's notions of probability are peculiar to himself, or that he has such an overpowering faith in the truth of evolution that no extent of structural break between one animal and another is sufficient to destroy his conviction that evolution has taken place.

But this by the way. The importance of the admission that there is nothing in man's physical structure to interfere with his having been evolved from an ape is not lessened because it is grudgingly made and inconsistently qualified. And instead of jubilating over the extent of the enemy's retreat, it will be more worth while to lay siege to his last stronghold–the position that there is a distinction in kind between the mental faculties of man and those of brutes, and that in consequence of this distinction in kind no gradual progress from the mental faculties of the one to those of the other can have taken place.

The Quarterly Reviewer entrenches himself within formidable-looking psychological outworks, and there is no getting at him without attacking them one by one.

He begins by laying down the following proposition. "'Sensation' is not 'thought,' and no [153] amount of the former would constitute the most rudimentary condition of the latter, though sensations supply the conditions for the existence of 'thought' or 'knowledge'" (p. 67).

This proposition is true, or not, according to the sense in which the word "thought" is employed. Thought is not uncommonly used in a sense co-extensive with consciousness, and, especially, with those states of consciousness we call memory. If I recall the impression made by a colour or an odour, and distinctly remember blueness or muskiness, I may say with perfect propriety that I "think of" blue or musk; and, so long as the thought lasts, it is simply a faint reproduction of the state of consciousness to which I gave the name in question, when it first became known to me as a sensation.

Now, if that faint reproduction of a sensation, which we call the memory of it, is properly termed a thought, it seems to me to be a somewhat forced proceeding to draw a hard and fast line of demarcation between thoughts and sensations. If sensations are not rudimentary thoughts, it may be said that some thoughts are rudimentary sensations. No amount of sound constitutes an echo, but for all that no one would pretend that an echo is something of totally different nature from a sound. Again, nothing can be looser, or more inaccurate, than the assertion that "sensations supply the conditions for the existence of thought or knowledge." If this implies that sensations supply the [154] conditions for the existence of our memory of sensations or of our thoughts about sensations, it is a truism which it is hardly worth while to state so solemnly. If it implies that sensations supply anything else, it is obviously erroneous. And if it means, as the context would seem to show it does, that sensations are the subject-matter of all thought or knowledge, then it is no less contrary to fact, inasmuch as our emotions, which constitute a large part of the subject-matter of thought or of knowledge, are not sensations.

More eccentric still is the Quarterly Reviewer's next piece of psychology.

"Altogether, we may clearly distinguish at least six kinds of action to which the nervous system ministers:–

"I. That in which impressions received result in appropriate movements without the intervention of sensation or thought, as in the eases of injury above given.–This is the reflex action of the nervous system.

"II. That in which stimuli from without result in sensations through the agency of which their due effects are wrought out.–Sensation.

"III. That in which impressions received result in sensations which give rise to the observation of sensible objects.–Sensible perception.

"IV. That in which sensations and perceptions continue to coalesce, agglutinate, and combine in more or less complex aggregations, according to the laws of the association of sensible perceptions.–Association.

"The above four groups contain only indeliberate operations, consisting, as they do at the best, but of mere *presentative* sensible ideas in no way implying any reflective or *representative* faculty. Such actions minister to and form *Instinct.* Besides these, we may distinguish two other kinds of mental action, namely:–

[155] "V. That in which sensations and sensible perceptions are reflected on by thought, and recognised as our own, and we ourselves recognised by ourselves as affected and perceiving.–Self consciousness.

"VI. That in which we reflect upon our sensations or perceptions, and ask what they are, and why they are.–Reason.

"These two latter kinds of action are deliberate operations, performed, as they are, by means of representative ideas implying the use of a *reflective representative* faculty. Such actions distinguish the *intellect* or rational faculty. Now, we assert that possession in perfection of all the first four (*presentative*) kinds of action by no means implies the possession of the last two (*representative*) kinds. All persons, we think, must admit the truth of the following proposition:–

"Two faculties are distinct, not in degree but *in kind,* if we may possess the one in perfection without that fact implying that we possess the other also. Still more will this be the case if the two faculties tend to increase in an inverse ratio. Yet this is the distinction between the *instinctive* and the *intellectual* parts of man's nature.

"As to animals, we fully admit that they may possess all the first four groups of actions–that they may have, so to speak, mental images of sensible objects combined in all degrees of complexity, as governed by the laws of association. We deny to them, on the other hand, the possession of the last two kinds of mental action. We deny them, that is, the power of reflecting on their own existences, or of inquiring into the nature of objects and their causes. We deny that they know that they know or know themselves in knowing. In other words, we deny them *reason.* The possession of the presentative faculty, as above explained, in no way implies that of the reflective faculty; nor does any amount of direct operation imply the power of asking the reflective question before mentioned, as to 'what' and 'why.'" (*Loc. cit.* pp. 67, 68.)

Sundry points are worthy of notice in this remarkable account of the intellectual powers. In the first place the Reviewer ignores emotion and [156] volition, though they are no inconsiderable "kinds of action to which the nervous system ministers," and memory has a place in his classification only by implication. Secondly, we are told that the second "kind of action to which the nervous system ministers" is "that in which stimuli from without result in sensations through the agency of which their due effects are wrought out.–Sensation." Does this really mean that, in the writer's opinion, "sensation" is the "agent" by which the "due effect" of the stimulus, which gives rise to sensation, is "wrought out"? Suppose somebody runs a pin into me. The "due effect" of that particular stimulus will probably be threefold; namely, a sensation of pain, a start, and an interjectional expletive. Does the Quarterly Reviewer really think that the "sensation" is the "agent" by which the other two phenomena are wrought out?

But these matters are of little moment to anyone but the Reviewer and those persons who may incautiously take their physiology, or psychology, from him. The really interesting point is this, that when he fully admits that animals "may possess all the first four groups of actions," he grants all that is necessary for the purposes of the evolutionist. For he hereby admits that in animals "impressions received result in sensations which give rise to the observation of sensible objects," and that they have what he calls [157] "sensible perception." Nor was it possible to help the admission; for we have as much reason to ascribe to animals, as we have to attribute to our fellow-men, the power, not only of perceiving external objects as external, and thus practically recognizing the difference between the self and the not-self; but that of distinguishing between like and unlike, and between simultaneous and successive things. When a gamekeeper goes out coursing with a greyhound in leash, and a hare crosses the field of vision, he becomes the subject of those states of consciousness we call visual sensation, and that is all he receives from without. Sensation, as such, tells him nothing whatever about the cause of these states of consciousness; but the thinking faculty instantly goes to work upon the raw material of sensation furnished to it through the eye, and gives rise to a train of thoughts. First comes the thought that there is an object at a certain distance; then arises another thought–the perception of the likeness between the states of consciousness awakened by this object to those presented by memory, as, on some former occasion, called up by a hare; this is succeeded by another thought of the nature of an emotion–namely, the desire to possess the hare; then follows a longer or shorter train of other thoughts, which end in a volition and an act–the loosing of the greyhound from the leash. These several thoughts are the concomitants of a process [158] which goes on in the nervous system of the man. Unless the nerve-elements of the retina, of the optic nerve, of the brain, of the spinal cord, and of the nerves of the arms, went through certain physical changes in due order and correlation, the various states of consciousness which have been enumerated would not make their appearance. So that in this, as in all other intellectual operations, we have to distinguish two sets of successive changes–one in the physical basis of consciousness, and the other in consciousness itself; one set which may, and doubtless will, in course of time, be followed through all their complexities by the anatomist and the physicist, and one of which only the man himself can have immediate knowledge.

As it is very necessary to keep up a clear distinction between these two processes, let the one be called *neurosis* and the other *psychosis.* When the gamekeeper was first trained to his work every step in the

process of neurosis was accompanied by a corresponding step in that of psychosis, or nearly so. He was conscious of seeing something, conscious of making sure it was a hare, conscious of desiring to catch it, and therefore to loose the greyhound at the right time, conscious of the acts by which he let the dog out of the leash. But with practice, though the various steps of the [159] psychosis remain–for otherwise the impression on the retina would not result in the loosing of the dog–the great majority of the steps of the psychosis vanish, and the loosing of the dog follows unconsciously, or as we say, without thinking about it, upon the sight of the hare. No one will deny that the series of acts which originally intervened between the sensation and the letting go of the dog were, in the strictest sense, intellectual and rational operations. Do they cease to be so when the man ceases to be conscious of them? That depends upon what is the essence and what the accident of those operations, which, taken together, constitute ratiocination.

Now ratiocination is resolvable into predication, and predication consists in marking, in some way, the existence, the co-existence, the succession, the likeness and unlikeness, of things or their ideas. Whatever does this, reasons; and if a machine produces the effects of reason, I see no more ground for denying to it the reasoning power, because it is unconscious, than I see for refusing to Mr. Babbage's engine the title of a calculating machine on the same grounds.

Thus it seems to me that a gamekeeper reasons, whether he is conscious or unconscious, whether his reasoning is carried on by neurosis alone, or whether it involves more or less psychosis. And if this is true of the gamekeeper, it is also true of the greyhound. The essential resemblances in all points of structure and function, so far as they can be studied, between the nervous system of the man and that of the dog, leave no reasonable doubt [160] that the processes which go on in the one are just like those which take place in the other. In the dog, there can be no doubt that the nervous matter which lies between the retina and the muscles undergoes a series of changes, precisely analogous to those which, in the man, give rise to sensation, a train of thought, and volition.

Whether this neurosis is accompanied by such psychosis as ours it is impossible to say; but those who deny that the nervous changes, which, in the dog, correspond with those which underlie thought in a man, are accompanied by consciousness, are equally bound to maintain that those nervous changes in the dog, which correspond with those which underlie sensation in a man, are also unaccompanied by consciousness. In other words, if there is no ground for believing that a dog thinks, neither is there any for believing that he feels.

As is well known, Descartes boldly faced this dilemma, and maintained that all animals were mere machines and entirely devoid of consciousness. But he did not deny, nor can anyone deny, that in this case they are reasoning machines, capable of performing all those operations which are performed by the nervous system of man when he reasons. For even supposing that in man, and in man only, psychosis is superadded to neurosis–the neurosis which is common to both man and animal gives their reasoning processes a fundamental unity. But Descartes' position is open to very [161] serious objections if the evidence that animals feel is insufficient to prove that they really do so. What is the value of the evidence which leads one to believe that one's fellow-man feels? The only evidence in this argument of analogy is the similarity of his structure and of his actions to one's own. And if that is good enough to

prove that one's fellow-man feels, surely it is good enough to prove that an ape feels. For the differences of structure and function between men and apes are utterly insufficient to warrant the assumption that while men have those states of consciousness we call sensations apes have nothing of the kind. Moreover, we have as good evidence that apes are capable of emotion and volition as we have that men other than ourselves are. But if apes possess three out of the four kinds of states of consciousness which we discover in ourselves, what possible reason is there for denying them the fourth? If they are capable of sensation, emotion, and volition, why are they to be denied thought (in the sense of predication)?

No answer has ever been given to these questions. And as the law of continuity is as much opposed, as is the common sense of mankind, to the notion that all animals are unconscious machines, it may safely be assumed that no sufficient answer ever will be given to them.

There is every reason to believe that consciousness is a function of nervous matter, when [162] that nervous matter has attained a certain degree of organisation, just as we know the other "actions to which the nervous system ministers," such as reflex action and the like, to be. As I have ventured to state my view of the matter elsewhere, "our thoughts are the expression of molecular changes in that matter of life which is the source of our other vital phenomena."

Mr. Wallace objects to this statement in the following terms:–

"Not having been able to find any clue in Professor Huxley's writings to the steps by which he passes from those vital phenomena, which consist only, in their last analysis, of movements by particles of matter, to those other phenomena which we term thought, sensation, or consciousness; but, knowing that so positive an expression of opinion from him will have great weight with many persons, I shall endeavour to show, with as much brevity as is compatible with clearness, that this theory is not only incapable of proof, but is also, as it appears to me, inconsistent with accurate conceptions of molecular physics."

With all respect for Mr. Wallace, it appears to me that his remarks are entirely beside the question. I really know nothing whatever, and never hope to know anything, of the steps by which the passage from molecular movement to states of consciousness is effected; and I entirely agree with the sense of the passage which he quotes from Professor Tyndall, apparently imagining that it is in opposition to the view I hold.

All that I have to say is, that, in my belief, consciousness and molecular action are capable of [163] being expressed by one another, just as heat and mechanical action are capable of being expressed in terms of one another. Whether we shall ever be able to express consciousness in foot-pounds, or not, is more than I will venture to say; but that there is evidence of the existence of some correlation between mechanical motion and consciousness, is as plain as anything can be. Suppose the poles of an electric battery to be connected by a platinum wire. A certain intensity of the current gives rise in the mind of a bystander to that state of consciousness we call a "dull red light"–a little greater intensity to another which we call a "bright red light;" increase the intensity, and the light becomes white; and, finally, it dazzles, and a new state of consciousness arises, which we term pain. Given the same wire and the same nervous apparatus, and the amount of electric force required to give rise to these several states of

consciousness will be the same, however often the experiment is repeated. And as the electric force, the light waves, and the nerve-vibrations caused by the impact of the light-waves on the retina, are all expressions of the molecular changes which are taking place in the elements of the battery; so consciousness is, in the same sense, an expression of the molecular changes which take place in that nervous matter, which is the organ of consciousness.

And, since this, and any number of similar [164] examples that may be required, prove that one form of consciousness, at any rate, is, in the strictest sense, the expression of molecular change, it really is not worth while to pursue the inquiry, whether a fact so easily established is consistent with any particular system of molecular physics or not.

Mr. Wallace, in fact, appears to me to have mixed up two very distinct propositions: the one, the indisputable truth that consciousness is correlated with molecular changes in the organ of consciousness; the other, that the nature of that correlation is known, or can be conceived, which is quite another matter. Mr. Wallace, presumably, believes in that correlation of phenomena which we call cause and effect as firmly as I do. But if he has ever been able to form the faintest notion how a cause gives rise to its effect, all I can say is that I envy him. Take the simplest case imaginable–suppose a ball in motion to impinge upon another ball at rest. I know very well, as a matter of fact, that the ball in motion will communicate some of its motion to the ball at rest, and that the motion of the two balls, after collision, is precisely correlated with the masses of both balls and the amount of motion of the first. But how does this come about? In what manner can we conceive that the *vis viva* of the first ball passes into the second? I confess I can no more form any conception of what happens in this case, than I can of what takes place when the motion of [165] particles of my nervous matter, caused by the impact of a similar ball gives rise to the state of consciousness I call pain. In ultimate analysis everything is incomprehensible, and the whole object of science is simply to reduce the fundamental incomprehensibilities to the smallest possible number.

But to return to the Quarterly Reviewer. He admits that animals have "mental images of sensible objects, combined in all degrees of complexity, as governed by the laws of association." Presumably, by this confused and imperfect statement the Reviewer means to admit more than the words imply. For mental images of sensible objects, even though "combined in all degrees of complexity," are, and can be, nothing more than mental images of sensible objects. But judgments, emotions, and volitions cannot by any possibility be included under the head of "mental images of sensible objects." If the greyhound had no better mental endowment than the Reviewer allows him, he might have the "mental image" of the "sensible object"–the hare–and that might be combined with the mental images of other sensible objects, to any degree of complexity, but he would have no power of judging it to be at a certain distance from him; no power of perceiving its similarity to his memory of a hare; and no desire to get at it. Consequently he would stand stock still, and the noble art of [166] coursing would have no existence. On the other hand, as that art is largely practised, it follows that greyhounds alone possess a number of mental powers, the existence of which, in any animal, is absolutely denied by the Quarterly Reviewer.

Finally, what are the mental powers which he reserves as the especial prerogative of man? They are two. First, the recognition of "ourselves by ourselves as affected and perceiving.–Self-consciousness."

Secondly. "The reflection upon our sensations and perceptions, and asking what they are and why they are.–Reason."

To the faculty defined in the last sentence, the Reviewer, without assigning the least ground for thus departing from both common usage and technical propriety, applies the name of reason. But if man is not to be considered a reasoning being, unless he asks what his sensations and perceptions are, and why they are, what is a Hottentot, or an Australian "black-fellow"; or what the "swinked hedger" of an ordinary agricultural district? Nay, what becomes of an average country squire or parson? How many of these worthy persons who, as their wont is, read the *Quarterly Review,* would do other than stand agape, if you asked them whether they had ever reflected what their sensations and perceptions are and why they are?

So that if the Reviewer's new definition of rea[167]son be correct, the majority of men, even among the most civilised nations, are devoid of that supreme characteristic of manhood. And if it be as absurd as I believe it to be, then, as reason is certainly not self-consciousness, and since it, as certainly, is one of the "actions to which the nervous system ministers," we must, if the Reviewer's classification is to be adopted, seek it among those four faculties which he allows animals to possess. And thus, for the second time, he really surrenders, while seeming to defend, his position.

The Quarterly Reviewer, as we have seen, lectures the evolutionists upon their want of knowledge of philosophy altogether. Mr. Mivart is not less pained at Mr. Darwin's ignorance of moral science. It is grievous to him that Mr. Darwin (and *nous autres*) should not have grasped the elementary distinction between material and formal morality; and he lays down as an axiom, of which no tyro ought to be ignorant, the position that "acts, unaccompanied by mental acts of conscious will directed towards the fulfilment of duty," are "absolutely destitute of the most incipient degree of real or formal goodness."

Now this may be Mr. Mivart's opinion, but it is a proposition which really does not stand on the footing of an undisputed axiom. Mr. Mill denies it in his work on Utilitarianism. The most influential writer of a totally opposed school, Mr. Carlyle, is never weary of denying it, and upholding [168] the merit of that virtue which is unconscious; nay, it is, to my understanding, extremely hard to reconcile Mr. Mivart's dictum with that noble summary of the whole duty of man–"Thou shalt love the Lord thy God with all thy heart, and with all thy soul, and with all thy strength; and thou shalt love thy neighbour as thyself." According to Mr. Mivart's definition, the man who loves God and his neighbour, and, out of sheer love and affection for both, does all he can to please them, is, nevertheless, destitute of a particle of real goodness.

And it further happens that Mr. Darwin, who is charged by Mr. Mivart with being ignorant of the distinction between material and formal goodness, discusses the very question at issue in a passage which is well worth reading (vol. i. p. 87), and also comes to a conclusion opposed to Mr. Mivart's axiom. A proposition which has been so much disputed and repudiated, should, under no circumstances, have been thus confidently assumed to be true. For myself, I utterly reject it, inasmuch as the logical

consequence of the adoption of any such principle is the denial of all moral value to sympathy and affection. According to Mr. Mivart's axiom, the man who, seeing another struggling in the water, leaps in at the risk of his own life to save him, does that which is "destitute of the most incipient degree of real goodness," unless, as he strips off his coat, he says to himself, "Now, mind, I am going to do this because it is my duty and [169] for no other reason;" and the most beautiful character to which humanity can attain, that of the man who does good without thinking about it, because he loves justice and mercy and is repelled by evil, has no claim on our moral approbation. The denial that a man acts morally because he does not think whether he does so or not, may be put upon the same footing as the denial of the title of an arithmetician to the calculating boy, because he did not know how he worked his sums. If mankind ever generally accept and act upon Mr. Mivart's axiom, they will simply become a set of most unendurable prigs; but they never have accepted it, and I venture to hope that evolution has nothing so terrible in store for the human race.

But if an action, the motive of which is nothing but affection or sympathy, may be deserving of moral approbation and really good, who that has ever had a dog of his own will deny that animals are capable of such actions? Mr. Mivart indeed says:–"It may be safely affirmed, however, that there is no trace in brutes of any actions simulating morality which are not explicable by the fear of punishment, by the hope of pleasure, or by personal affection" (p. 221). But it may be affirmed, with equal truth, that there is no trace in men of any actions which are not traceable to the same motives. If a man does anything, he does it either because he fears to be punished if he does not do it, or because he hopes to obtain pleasure [170] by doing it, or because he gratifies his affections[17] by doing it.

Assuming the position of the absolute moralists, let it be granted that there is a perception of right and wrong innate in every man. This means, simply, that when certain ideas are presented to his mind, the feeling of approbation arises; and when certain others, the feeling of disapprobation. To do your duty is to earn the approbation of your conscience, or moral sense; to fail in your duty is to feel its disapprobation, as we all say. Now, is approbation a pleasure or a pain? Surely a pleasure. And is disapprobation a pleasure or a pain? Surely a pain. Consequently, all that is really meant by the absolute moralists is that there is, in the very nature of man, something which enables him to be conscious of these particular pleasures and pains. And when they talk of immutable [171] and eternal principles of morality, the only intelligible sense which I can put upon the words, is that the nature of man being what it is, he always has been, and always will be capable of feeling these particular pleasures and pains. *A priori*, I have nothing to say against this proposition. Admitting its truth, I do not see how the moral faculty is on a different footing from any of the other faculties of man. If I choose to say that it is an immutable and eternal law of human nature that "ginger is hot in the mouth," the assertion has as much foundation of truth as the other, though I think it would be expressed in needlessly pompous language. I must confess that I have never been able to understand why there should be such a bitter quarrel between the intuitionists and the utilitarians. The intuitionist is, after all, only a utilitarian who believes that a particular class of pleasures and pains has an especial importance, by reason of its foundation in the nature of man, and its inseparable connection with his very existence as a thinking being. And as regards the motive of personal affection: Love, as Spinoza profoundly says, is the association of pleasure with that which is loved.[18] Or, to put it to the common sense of mankind, is the gratification of affection a

pleasure or a pain? Surely a pleasure. So that whether the motive which leads us to perform an action is the love of our neighbour, or the love of God, it is undeniable that pleasure enters into that motive.

Thus much in reply to Mr. Mivart's arguments. I cannot but think that it is to be regretted that he ekes them out by ascribing to the doctrines of the philosophers with whom he does not agree, logical consequences which have been over and over again proved not to flow from them: and when reason fails him, tries the effect of an injurious [172] nickname. According to the views of Mr. Spencer, Mr. Mill, and Mr. Darwin, Mr. Mivart tells us, "*virtue is a mere kind of retrieving*" and, that we may not miss the point of the joke, he puts it in italics. But what if it is? Does that make it less virtue? Suppose I say that sculpture is a "mere way" of stone-cutting, and painting a "mere way" of daubing canvas, and music a "mere way" of making a noise, the statements are quite true; but they only show that I see no other method of depreciating some of the noblest aspects of humanity than that of using language in an inadequate and misleading sense about them. And the peculiar inappropriateness of this particular nickname to the views in question, arises from the circumstance which Mr. Mivart would doubtless have recollected, if his wish to ridicule had not for the moment obscured his judgment–that whether the law of evolution applies to man or not, that of hereditary transmission certainly does. Mr. Mivart will hardly deny that a man owes a large share of the moral tendencies which he exhibits to his ancestors; and the man who inherits a desire to steal from a kleptomaniac, or a tendency to benevolence from a Howard, is, so far as he illustrates hereditary transmission, comparable to the dog who inherits the desire to fetch a duck out of the water from his retrieving sire. So that, evolution, or no evolution, moral qualities are comparable to a [173] "kind of retrieving;" though the comparison, if meant for the purposes of casting obloquy on evolution, does not say much for the fairness of those who make it.

The Quarterly Reviewer and Mr. Mivart base their objections to the evolution of the mental faculties of man from those of some lower animal form upon what they maintain to be a difference in kind between the mental and moral faculties of men and brutes; and I have endeavoured to show, by exposing the utter unsoundness of their philosophical basis, that these objections are devoid of importance.

The objections which Mr. Wallace brings forward to the doctrine of the evolution of the mental faculties of man from those of brutes by natural causes, are of a different order, and require separate consideration.

If I understand him rightly, he by no means doubts that both the bodily and the mental faculties of man have been evolved from those of some lower animal; but he is of opinion that some agency beyond that which has been concerned in the evolution of ordinary animals has been operative in the case of man. "A superior intelligence has guided the development of man in a definite direction and for a special purpose, just as man guides the development of many animal and vegetable forms."[19] I understand this [174] to mean that, just as the rock-pigeon has been produced by natural causes, while the evolution of the tumbler from the blue rock has required the special intervention of the intelligence of man, so some anthropoid form may have been evolved by variation and natural selection; but it could never have given rise to man, unless some superior intelligence had played the part of the pigeon-fancier.

According to Mr. Wallace, "whether we compare the savage with the higher developments of man, or

with the brutes around him, we are alike driven to the conclusion, that, in his large and well-developed brain, he possesses an organ quite disproportioned to his requirements" (p. 343); and he asks, "What is there in the life of the savage but the satisfying of the cravings of appetite in the simplest and easiest way? What thoughts, idea, or actions are there that raise him many grades above the elephant or the ape?" (p. 342.) I answer Mr. Wallace by citing a remarkable passage which occurs in his instructive paper on "Instinct in Man and Animals."

"Savages make long journeys in many directions, and, their whole faculties being directed to the subject, they gain a wide and accurate knowledge of the topography, not only of their own district, but of all the regions round about. Every one who has travelled in a new direction communicates his knowledge to those who have travelled less, and descriptions of routes and localities, and minute incidents of travel, form one of the main staples of conversation around the evening fire. Every wanderer or captive from another tribe adds to the store of [175] information, and, as the very existence of individuals and of whole families and tribes depends upon the completeness of this knowledge, all the acute perceptive faculties of the adult savage are directed to acquiring and perfecting it. The good hunter or warrior thus comes to know the bearing of every hill and mountain range, the directions and junctions of all the streams, the situation of each tract characterised by peculiar vegetation, not only within the area he has himself traversed, but perhaps for a hundred miles around it. His acute observation enables him to detect the slightest undulations of the surface, the various changes of subsoil and alterations in the character of the vegetation that would be quite imperceptible to a stranger. His eye is always open to the direction in which he is going; the mossy side of trees, the presence of certain plants under the shade of rocks, the morning and evening flight of birds, are to him indications of direction almost as sure as the sun in the heavens" (pp. 207, 208).

I have seen enough of savages to be able to declare that nothing can be more admirable than this description of what a savage has to learn. But it is incomplete. Add to all this the knowledge which a savage is obliged to gain of the properties of plants, of the characters and habits of animals, and of the minute indications by which their course is discoverable: consider that even an Australian can make excellent baskets and nets, and neatly fitted and beautifully balanced spears, that he learns to use these so as to be able to transfix a quartern loaf at sixty yards; and that very often, as in the case of the American Indians, the language of a savage exhibits complexities which a well-trained European finds it difficult to master: consider that every time a savage tracks [176] his game he employs a minuteness of observation, and an accuracy of inductive and deductive reasoning which, applied to other matters, would assure some reputation to a man of science, and I think we need ask no further why he possesses such a fair supply of brains. In complexity and difficulty, I should say that the intellectual labour of a "good hunter or warrior" considerably exceeds that of an ordinary Englishman. The Civil Service Examiners are held in great terror by young Englishmen; but even their ferocity never tempted them to require a candidate to possess such a knowledge of a parish as Mr. Wallace justly points out savages may possess of an area a hundred miles or more in diameter.

But suppose, for the sake of argument, that a savage has more brains than seems proportioned to his wants, all that can be said is that the objection to natural selection, if it be one, applies quite as strongly to the lower animals. The brain of a porpoise is quite wonderful for its mass, and for the development of the cerebral convolutions. And yet since we have ceased to credit the story of Arion, it is hard to believe that porpoises are much troubled with intellect: and still more difficult is it to imagine that their big

brains are only a preparation for the advent of some accomplished cetacean of the future. Surely, again, a wolf must have too much brains, or else how is it that a dog with only the same quantity and form of brain is [177] able to develop such singular intelligence? The wolf stands to the dog in the same relation as the savage to the man; and, therefore, if Mr. Wallace's doctrine holds good, a higher power must have superintended the breeding up of wolves from some inferior stock, in order to prepare them to become dogs.

Mr. Wallace further maintains that the origin of some of man's mental faculties by the preservation of useful variations is not possible. Such, for example, are "the capacity to form ideal conceptions of space and time, of eternity and infinity; the capacity for intense artistic feelings of pleasure in form, colour, and composition; and for those abstract notions of form and number which render geometry and arithmetic possible." "How," he asks, "were all or any of these faculties first developed, when they could have been of no possible use to man in his early stages of barbarism?"

Surely the answer is not far to seek. The lowest savages are as devoid of any such conceptions as the brutes themselves. What sort of conceptions of space and time, of form and number, can be possessed by a savage who has not got so far as to be able to count beyond five or six, who does not know how to draw a triangle or a circle, and has not the remotest notion of separating the particular quality we call form, from the other qualities of bodies? None of these capacities are exhibited by men, unless they form part of a [178] tolerably advanced society. And, in such a society, there are abundant conditions by which a selective influence is exerted in favour of those persons who exhibit an approximation towards the possession of these capacities.

The savage who can amuse his fellows by telling a good story over the nightly fire, is held by them in esteem and rewarded, in one way or another, for so doing–in other words, it is an advantage to him to possess this power. He who can carve a paddle, or the figure-head of a canoe better, similarly profits beyond his duller neighbour. He who counts a little better than others, gets most yams when barter is going on, and forms the shrewdest estimate of the numbers of an opposing tribe. The experience of daily life shows that the conditions of our present social existence exercise the most extraordinarily powerful selective influence in favour of novelists, artists, and strong intellects of all kinds; and it seems unquestionable that all forms of social existence must have had the same tendency, if we consider the indisputable facts that even animals possess the power of distinguishing form and number, and that they are capable of deriving pleasure from particular forms and sounds. If we admit, as Mr. Wallace does, that the lowest savages are not raised "many grades above the elephant and the ape;" and if we further admit, as I contend must be admitted, that the conditions of social life tend, powerfully, to [179] give an advantage to those individuals who vary in the direction of intellectual or æsthetic excellence, what is there to interfere with the belief that these higher faculties, like the rest, owe their development to natural selection?

Finally, with respect to the development of the moral sense out of the simple feelings of pleasure and pain, liking and disliking, with which the lower animals are provided, I can find nothing in Mr. Wallace's reasonings which has not already been met by Mr. Mill, Mr. Spencer, or Mr. Darwin.

I do not propose to follow the Quarterly Reviewer and Mr. Mivart through the long string of objections in matters of detail which they bring against Mr. Darwin's views. Every one who has considered the matter carefully will be able to ferret out as many more "difficulties"; but he will also, I believe, fail as completely as they appear to me to have done, in bringing forward any fact which is really contradictory of Mr. Darwin's views. Occasionally, too, their objections and criticisms are based upon errors of their own. As, for example, when Mr. Mivart and the Quarterly Reviewer insist upon the resemblances between the eyes of *Cephalopoda* and*Vertebrata,* quite forgetting that there are striking and altogether fundamental differences between them; or when the Quarterly Reviewer corrects Mr. Darwin [180] for saying that the gibbons, "without having been taught, can walk or run upright with tolerable quickness, though they move awkwardly, and much less securely than man." The Quarterly Reviewer says, "This is a little misleading, inasmuch as it is not stated that this upright progression is effected by placing the enormously long arms behind the head, or holding them out backwards as a balance in progression."

Now, before carping at a small statement like this, the Quarterly Reviewer should have made sure that he was quite right. But he happens to be quite wrong. I suspect he got his notion of the manner in which a gibbon walks from a citation in "Man's Place in Nature." But at that time I had not seen a gibbon walk. Since then I have, and I can testify that nothing can be more precise than Mr. Darwin's statement. The gibbon I saw walked without either putting his arms behind his head or holding them out backwards. All he did was to touch the ground with the outstretched fingers of his long arms now and then, just as one sees a man who carries a stick, but does not need one, touch the ground with it as he walks along.

Again, a large number of the objections brought forward by Mr. Mivart and the Quarterly Reviewer apply to evolution in general, quite as much as to the particular form of that doctrine advocated by Mr. Darwin; or, to their notions of Mr. Darwin's views and not to what they really are. An excel[181]lent example of this class of difficulties is to be found in Mr. Mivart's chapter on "Independent Similarities of Structure." Mr. Mivart says that these cannot be explained by an "absolute and pure Darwinian," but "that an innate power and evolutionary law, aided by the corrective action of natural selection, should have furnished like needs with like aids, is not at all improbable" (p. 82).

I do not exactly know what Mr. Mivart means by an "absolute and pure Darwinian;" indeed Mr. Mivart makes that creature hold so many singular opinions that I doubt if I can ever have seen one alive. But I find nothing in his statement of the view which he imagines to be originated by himself, which is really inconsistent with what I understand to be Mr. Darwin's views.

I apprehend that the foundation of the theory of natural selection is the fact that living bodies tend incessantly to vary. This variation is neither indefinite, nor fortuitous, nor does it take place in all directions, in the strict sense of these words.

Accurately speaking, it is not indefinite, nor does it take place in all directions, because it is limited by the general characters of the type to which the organism exhibiting the variation belongs. A whale does not tend to vary in the direction of producing feathers, nor a bird in the direction of developing whalebone. In popular language there is no harm in saying that the [182] waves which break upon the

sea-shore are indefinite, fortuitous, and break in all directions. In scientific language, on the contrary, such a statement would be a gross error, inasmuch as every particle of foam is the result of perfectly definite forces, operating according to no less definite laws. In like manner, every variation of a living form, however minute, however apparently accidental, is inconceivable except as the expression of the operation of molecular forces or "powers" resident within the organism. And, as these forces certainly operate according to definite laws, their general result is, doubtless, in accordance with some general law which subsumes them all. And there appears to be no objection to call this an "evolutionary law." But nobody is the wiser for doing so, or has thereby contributed, in the least degree, to the advance of the doctrine of evolution, the great need of which is a theory of variation.

When Mr. Mivart tells us that his "aim has been to support the doctrine that these species have been evolved by ordinary *natural laws* (for the most part unknown), aided by the *subordinate* action of 'natural selection' "(pp. 332-3), he seems to be of opinion that his enterprise has the merit of novelty. All I can say is that I have never had the slightest notion that Mr. Darwin's aim is in any way different from this. If I affirm that "species have been evolved by variation[20] (a natural [183] process, the laws of which are for the most part unknown), aided by the subordinate action of natural selection," it seems to me that I enunciate a proposition which constitutes the very pith and marrow of the first edition of the "Origin of Species." And what the evolutionist stands in need of just now, is not an iteration of the fundamental principle of Darwinism, but some light upon the questions, What are the limits of variation? and, If a variety has arisen, can that variety be perpetuated, or even intensified, when selective conditions are indifferent, or perhaps unfavourable to its existence? I cannot find that Mr. Darwin has ever been very dogmatic in answering these questions. Formerly, he seems to have inclined to reply to them in the negative, while now his inclination is the other way. Leaving aside those broad questions of theology, philosophy, and ethics, by the discussion of which neither the Quarterly Reviewer nor Mr. Mivart can be said to have damaged Darwinism–whatever else they have injured–this is what their criticisms come to. They confound a struggle for some rifle-pits with an assault on the fortress.

In some respects, finally, I can only characterise the Quarterly Reviewer's treatment of Mr. Darwin as alike unjust and unbecoming. Language of this strength requires justification, and on that ground I add the remarks which follow.

The Quarterly Reviewer opens his essay by a [184] careful enumeration of all those points upon which, during the course of thirteen years of incessant labour, Mr. Darwin has modified his opinions. It has often and justly been remarked, that what strikes a candid student of Mr. Darwin's works is not so much his industry, his knowledge, or even the surprising fertility of his inventive genius; but that unswerving truthfulness and honesty which never permit him to hide a weak place, or gloss over a difficulty, but lead him, on all occasions, to point out the weak places in his own armour, and even sometimes, it appears to me, to make admissions against himself which are quite unnecessary. A critic who desires to attack Mr. Darwin has only to read his works with a desire to observe, not their merits, but their defects, and he will find, ready to hand, more adverse suggestions than are likely ever to have suggested themselves to his own sharpness, without Mr. Darwin's self-denying aid.

Now this quality of scientific candour is not so common that it needs to be discouraged; and it appears to me to deserve other treatment than that adopted by the Quarterly Reviewer, who deals with Mr. Darwin as an Old Bailey barrister deals with a man against whom he wishes to obtain a conviction, *per fas aut nefas*, and opens his case by endeavouring to create a prejudice against the prisoner in the minds of the jury. In his eagerness to carry out this laudable desire, the Quarterly [185] Reviewer cannot even state the history of the doctrine of natural selection without an oblique and entirely unjustifiable attempt to depreciate Mr. Darwin. "To Mr. Darwin," says he, "and (through Mr. Wallace's reticence) to Mr. Darwin alone, is due the credit of having first brought it prominently forward and demonstrated its truth." No one can less desire than I do, to throw a doubt upon Mr. Wallace's originality, or to question his claim to the honour of being one of the originators of the doctrine of natural selection; but the statement that Mr. Darwin has the sole credit of originating the doctrine because of Mr. Wallace's reticence is simply ridiculous. The proof of this is, in the first place, afforded by Mr. Wallace himself, whose noble freedom from petty jealousy in this matter smaller folk would do well to imitate, and who writes thus:–"I have felt all my life, and I still feel, the most sincere satisfaction that Mr. Darwin had been at work long before me and that it was not left for me to attempt to write the 'Origin of Species.' I have long since measured my own strength, and know well that it would be quite unequal to that task." So that if there was any reticence at all in the matter, it was Mr. Darwin's reticence during the long twenty years of study which intervened between the conception and the publication of his theory, which gave Mr. Wallace the chance of being an independent discoverer of the importance of natural [186] selection. And, finally, if it be recollected that Mr. Darwin's and Mr. Wallace's essays were published simultaneously in the "Journal of the Linnæan Society" for 1858, it follows that the Reviewer, while obliquely depreciating Mr. Darwin's deserts, has in reality awarded to him a priority which, in legal strictness, does not exist.

Mr. Mivart, whose opinions so often concur with those of the Quarterly Reviewer, puts the case in a way, which I much regret to be obliged to say, is, in my judgment, quite as incorrect; though the injustice may be less glaring. He says that the theory of natural selection is, in general, exclusively associated with the name of Mr. Darwin, "on account of the noble self-abnegation of Mr. Wallace." As I have said, no one can honour Mr. Wallace more than I do, both for what he has done and for what he has not done, in his relation to Mr. Darwin. And perhaps nothing is more creditable to him than his frank declaration that he could not have written such a work as the "Origin of Species." But, by this declaration, the person most directly interested in the matter repudiates, by anticipation, Mr. Mivart's suggestion that Mr. Darwin's eminence is more or less due to Mr. Wallace's modesty.

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[1] 1. *Contributions to the Theory of Natural Selection.* By A. R. Wallace. 1870.–2. *The Genesis of Species.* By St. George Mivart, F.R.S. Second Edition. 1871.–3. *Darwin's Descent of Man. Quarterly Review,* July 1871.

[2] Helmholtz: *Ueber das Ziel und die Fortschritte der Naturwissenschaft.* Eröffnungsrede für die Naturforscherversammlung zu Innsbruck. 1869.

[3] See the *Tablet* for March 11, 1871.

[4] It should be observed that Mr. Mivart employs the term "Christian" as if it were the equivalent of "Catholic."

[5] Suarez, *Metaphysica.* Edition Vivés. Paris, 1868, vol. i. Disput. xv. § 2.

[6] The edition of Suarez's *Disputationes* from which the following citations are given, is Birckmann's, in two volumes folio, and is dated 1630.

[7] Suarez, *loc. cit.* Disput. xv. § ii.

[8] *Tractatus de opere sex Dierum, seu de Universi Creatione, quatenus sex diebus perfecta esse, in libro Genesis cap. i. refertur et præsertim de productione hominis in statu innocentiæ.* Ed. Birckmann, 1622.

[9] "Propter hæc ergo sententia illa Augustini et propter nimiam obscuritatem et subtilitatem ejus difficilis creditu est: quia verisimile non est Deum inspirasse Moysi, ut historiam de creatione mundi ad fidem totius populi adeo necessariam per nomina dierum explicaret, quorum significatio vix inveniri et difficillime ab aliquo credi posset." (*Loc cit.*. Lib. I. cap. xi. 42.)

[10] *Loc. cit.* Lib. II. cap. vii. et viii. 1, 32, 25.

[11] *Loc. cit.* Lib. II. cap. vii. et viii. 1, 32, 35.

[12] Disput. xv. § x. No. 27.

[13] Disput. xv. "De causa formali substantiali," § x. No. 24.

[14] *Tractatus de Opere,* Lib.III. "De hominis creatione," cap. ii. No. 3.

[15] *Ibid.* Lib. III. cap. iv. Nos. 8 and 9.

[16] Charge at the Diocesan Synod of Brechin. *Scotsman,* Sept. 14, 1871.

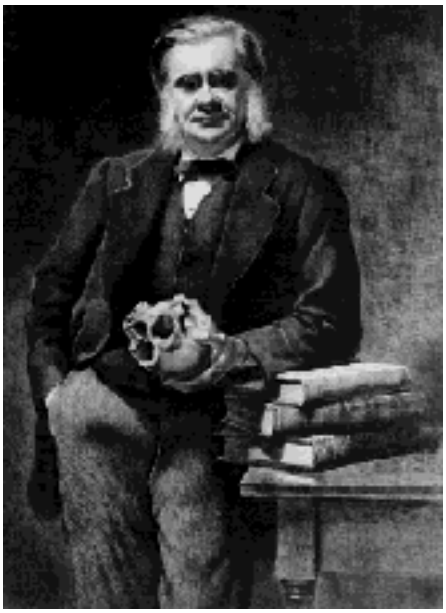
[17] In separating pleasure and the gratification of affection, I simply follow Mr. Mivart without admitting the justice of the separation.

[18] "Nempe, Amor nihil aliud est, quam Lætitia, concomitante idea causæ externæ."–*Ethices,* III. xiii.

[19] "The Limits of Natural Selection as applied to Man" (*loc. cit.* p. 359).

[20] Including under this head hereditary transmission.

THE HUXLEY FILE



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Next article: Evolution in Biology [1878], pages 187-226.

Previous article: The Genealogy of Animals [1869], pages 107-119.

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Evolution in Biology (1878)

Collected Essays II

[187] In the former half of the eighteenth century, the term "evolution" was introduced into biological writings, in order to denote the mode in which some of the most eminent physiologists of that time conceived that the generations of living things took place; in opposition to the hypothesis advocated, in the preceding century, by Harvey in that remarkable work[1] which would give him a claim to rank among the founders of biological science, even had he not been the discoverer of the circulation of the blood.

One of Harvey's prime objects is to defend and establish, on the basis of direct observation, the opinion already held by Aristotle; that, in the higher animals at any rate, the formation of the [188] new organism by the process of generation takes place, not suddenly, by simultaneous accretion of rudiments of all, or of the most important, of the organs of the adult; nor by sudden metamorphosis of a formative substance into a miniature of the whole, which subsequently grows; but by *epigenesis,* or successive differentiation of a relatively homogeneous rudiment into the parts and structures which are characteristic of the adult.

"Et primo, quidem, quoniam per *epigenesin* sive partium superexorientium additamentum pullum fabricari certum est: quænam pars ante alias omnes exstruatur, et quid de illa ejusque generandi modo observandum veniat, dispiciemus. Ratum sane est et in ovo manifestè apparet quod *Aristoteles* de perfectorum animalium generatione enuntiat: nimirum, non omnes partes simul fieri, sed ordine aliam post aliam; primùmque existere particulam genitalem, cujus virtute postea (tanquam ex principio quodam) reliquæ omnes partes prosiliant. Qualem in plantarum seminibus (fabis, putà, aut glandibus) gemmam sive apicem protuberantem cernimus, totius futuræ arboris principium. *Estque hæc particula velut filius emancipatus seorsumque collocatus, et principium per se vivens; unde postea membrorum ordo describitur; et quæcunque ad absolvendum animal pertinent, disponuntur.*[2] Quoniam enim *nulla pars se ipsam generat; sed postquam generata est, se ipsam jam auget; ideo eam primùm oriri necesse est, quæ principium augendi contineat (sive enim planta, sive animal est, æque omnibus inest quod vim habeat vegetandi, sive nutriendi*),[3] simulque reliquas omnes partes suo quomque ordine distinguat et formet; proindeque in eadem primogenita particula anima primario inest, sensus, motusque, et totius vitæ auctor et principium." (Exercitatio 51.)

[189] Harvey proceeds to contrast this view with that of the "Medici," or followers of Hippocrates and Galen, who, "badly philosophising," imagined that the brain, the heart, and the liver were simultaneously first generated in the form of vesicles; and, at the same time, while expressing his agreement with Aristotle in the principle of epigenesis, he maintains that it is the blood which is the primal generative part, and not, as Aristotle thought, the heart.

In the latter part of the seventeenth century, the doctrine of epigenesis, thus advocated by Harvey, was controverted, on the ground of direct observation, by Malpighi, who affirmed that the body of the chick is to be seen in the egg, before the *punctum sanguineum* makes it [sic] appearance. But, from this

perfectly correct observation a conclusion which is by no means warranted was drawn; namely, that the chick, as a whole, really exists in the egg antecedently to incubation; and that what happens in the course of the latter process is no addition of new parts, "alias post alias natas," as Harvey puts it, but a simple expansion, or unfolding, of the organs which already exist, though they are too small and inconspicuous to be discovered. The weight of Malpighi's observations therefore fell into the scale of that doctrine which Harvey terms *metamorphosis*, in contradistinction to epigenesis.

The views of Malphigi were warmly welcomed, [190] on philosophical grounds, by Leibnitz,[4] who found in them a support to his hypothesis of monads, and by Malebranche;[5] while, in the middle of the eighteenth century, not only speculative considerations, but a great number of new and interesting observations on the phenomena of generation, led the ingenious Bonnet, and Haller,[6] the first physiologist of the age, to adopt, advocate, and extend them.

[191] Bonnet affirms that, before fecundation, the hen's egg contains an excessively minute but complete chick; and that fecundation and incubation simply cause this germ to absorb nutritious matters, which are deposited in the interstices of the elementary structures of which the miniature chick, or germ, is made up. The consequence of this intussusceptive growth is the "development" or "evolution" of the germ into the visible bird. Thus an organised individual (*tout organisé*) "is a composite body consisting of the original, or *elementary*, parts and of the matters which have been associated with them by the aid of nutrition;" so that, if these matters could be extracted from the individual (*tout*), it would, so to speak, become concentrated in a point, and would thus be restored to its primitive condition of a *germ;* "just as by extracting from a bone the calcareous substance which is the source of its hardness, it is reduced to its primitive state of gristle or membrane."[7]

"Evolution" and "development" are, for Bonnet, synonymous terms; and since by "evolution" he means simply the expansion of that which was invisible into visibility, he was naturally led to the conclusion, at which Leibnitz had arrived by a different line of reasoning, that no such thing as generation, in the proper sense of the word, exists in Nature. The growth of an [192] organic being is simply a process of enlargement as a particle of dry gelatine may be swelled up by the intussusception of water; its death is a shrinkage, such as the swelled jelly might undergo on desiccation. Nothing really new is produced in the living world, but the germs which develop have existed since the beginning of things; and nothing really dies, but, when what we call death takes place, the living thing shrinks back into its germ state.[8]

The two parts of Bonnet's hypothesis, namely, the doctrine that all living things proceed from pre-existing germs, and that these contain, one [193] inclosed within the other, the germs of all future living things, which is the hypothesis of "*emboîtement;*" and the doctrine that every germ contains in miniature all the organs of the adult, which is the hypothesis of evolution or development, in the primary senses of these words, must be carefully distinguished. In fact, while holding firmly by the former, Bonnet more or less modified the latter in his later writings, and, at length, he admits that a "germ" need not be an actual miniature of the organism; but that it may be merely an "original preformation" capable of producing the latter.[9]

But, thus defined, the germ is neither more nor less than the "particula genitalis" of Aristotle, or the "primordium vegetale" or "ovum" of Harvey; and the "evolution" of such a germ would not be distinguishable from "epigenesis."

Supported by the great authority of Haller, the doctrine of evolution, or development, prevailed throughout the whole of the eighteenth century, and Cuvier appears to have substantially adopted Bonnet's later views, though probably he would not have gone all lengths in the direction of "emboîtement." In a well-known note to Laurillard's "Eloge," prefixed to the last edition [194] of the "Ossemens fossiles," the "radical de l'être" is much the same thing as Aristotle's "particula genitalis" and Harvey's "ovum."[10]

Bonnet's eminent contemporary, Buffon, held nearly the same views with respect to the nature of the germ, and expresses them even more confidently.

"Ceux qui ont cru que le cœur étoit le premier formé, se sont trompés; ceux qui disent que c'est le sang se trompent aussi: tout est formé en même temps. Si l'on ne consulte que l'observation, le poulet se voit dans l'œuf avant qu'il ait été couvé."[11]

"J'ai ouvert une grande quantité d'œufs à differens temps avant et après l'incubation, et je me suis convaincu par mes yeux que le poulet existe en entier dans le milieu de la cicatricule au moment qu'il sort du corps de la poule."[12]

The "moule intérieur" of Buffon is the aggregate of elementary parts which constitute the individual, and is thus the equivalent of Bonnet's germ,[13] as defined in the passage cited above. But Buffon further imagined that innumerable "molecules organiques" are dispersed throughout the world, and that alimentation consists in the [195] appropriation by the parts of an organism of those molecules which are analogous to them. Growth, therefore, was, on this hypothesis, a process partly of simple evolution, and partly of what has been termed "syngenesis." Buffon's opinion is, in fact, a sort of combination of views, essentially similar to those of Bonnet, with others, somewhat similar to those of the "Medici" whom Harvey condemns. The "molecules organiques" are physical equivalents of Leibnitz's "monads."

It is a striking example of the difficulty of getting people to use their own powers of investigation accurately, that this form of the doctrine of evolution should have held its ground so long; for it was thoroughly and completely exploded, not long after its enunciation, by Casper Friederich Wolff, who in his "Theoria Generationis," published in 1759, placed the opposite theory of epigenesis upon the secure foundation of fact, from which it has never been displaced. But Wolff had no immediate successors. The school of Cuvier was lamentably deficient in embryologists; and it was only in the course of the first thirty years of the present century, that Prévost and Dumas in France, and, later on, Döllinger, Pander, Von Bär, Rathke, and Remak in Germany, founded modern embryology; while, at the same time, they proved the utter incompatibility of the hypothesis of evolution, as formulated by Bonnet and Haller, with easily demonstrable facts.

[196] Nevertheless, though the conceptions originally denoted by "evolution" and "development" were shown to be untenable, the words retained their application to the process by which the embryos of living beings gradually make their appearance; and the terms "Development," "Entwickelung," and "Evolution" are now indiscriminately used for the series of genetic changes exhibited by living beings, by writers who would emphatically deny that "Development" or "Entwickelung" or "Evolution" in the sense in which these words were usually employed by Bonnet or by Haller, ever occurs.

Evolution, or development, is, in fact, at present employed in biology as a general name for the history of the steps by which any living being has acquired the morphological and the physiological characters which distinguish it. As civil history may be divided into biography, which is the history of individuals, and universal history, which is the history of the human race, so evolution falls naturally into two categories–the evolution of the individual, and the evolution of the sum of living beings. It will be convenient to deal with the modern doctrine of evolution under these two heads.

I. *The Evolution of the Individual.*

No exception is at this time, known to the general law, established upon an immense multitude of direct observations, that every living thing [197] is evolved from a particle of matter in which no trace of the distinctive characters of the adult form of that living thing is discernible. This particle is termed a *germ.* Harvey[14] says–

"Omnibus viventibus primordium insit, ex quo et a quo proveniant. Liceat hoc nobis *primordium vegetale* nominare; nempe substantiam quandam corpoream vitam habentem potentiâ; vel quoddam per se existens, quod aptum sit, in vegetativam formam, ab interno principio operante, mutari. Quale nempe primordium, ovum est et plantarum semen; tale etiam viviparorum conceptus, et insectorum *vermis* ab Aristotele dictus: diversa scilicet diversorum viventium primordia."

The definition of a germ as "matter potentially alive, and having within itself the tendency to assume a definite living form," appears to meet all the requirements of modern science. For, notwithstanding it might be justly questioned whether a germ is not merely potentially, but rather actually, alive, though its vital manifestations are reduced to a minimum, the term "potential" may fairly be used in a sense broad enough to escape the objection. And the qualification of "potential" has the advantage of reminding us that the great characteristic of the germ is not so much what it is, but what it may, under suitable conditions, become. Harvey shared the belief of Aristotle–whose writings he so often quotes and of whom he speaks as his [198] precursor and model, with the generous respect with which one genuine worker should regard another–that such germs may arise by a process of "equivocal generation" out of not-living matter; and the aphorism so commonly ascribed to him, "*omne vivum ex ovo*," and which is indeed a fair summary of his reiterated assertions, though incessantly employed against the modern advocates of spontaneous generation, can be honestly so used only by those who have never read a score of pages of the "Exercitationes." Harvey, in fact, believed as implicitly as Aristotle did in the equivocal generation of the lower animals. But, while the course of modern investigation has only brought out into

greater prominence the accuracy of Harvey's conception of the nature and mode of development of germs, it has as distinctly tended to disprove the occurrence of equivocal generation, or abiogenesis, in the present course of nature. To the immense majority of both plants and animals, it is certain that the germ is not merely a body in which life is dormant or potential, but that it is itself simply a detached portion of the substance of a pre-existing living body; and the evidence has yet to be adduced which will satisfy any cautious reasoner that "omne vivum ex vivo" is not as well-established a law of the existing course of nature as "omne vivum ex ovo."

In all instances which have yet been investi[199]gated, the substance of this germ has a peculiar chemical composition, consisting of at fewest four elementary bodies, viz, carbon, hydrogen, oxygen, and nitrogen, united into the ill-defined compound known as protein, and associated with much water, and very generally, if not always, with sulphur and phosphorus in minute proportions. Moreover, up to the present time, protein is known only as a product and constituent of living matter. Again, a true germ is either devoid of any structure discernible by optical means, or, at most, it is a simple nucleated cell. [15]

In all cases the process of evolution consists in a succession of changes of the form, structure, and functions of the germ, by which it passes, step by step, from an extreme simplicity, or relative homogeneity, of visible structure, to a greater or less degree of complexity or heterogeneity; and the course of progressive differentiation is usually accompanied by growth, which is effected by intussusception. This intussusception, however, is a very different process from that imagined either by Buffon or by Bonnet. The substance by the addition of which the germ is enlarged is in no case simply absorbed, ready-made, from the not-living world and packed between the elementary constituents of the germ, as Bonnet imagined; [200] still less does it consist of the "molecules organiques" of Buffon. The new material is, in great measure, not only absorbed but assimilated, so that it becomes part and parcel of the molecular structure of the living body into which it enters. And, so far from the fully developed organism being simply the germ *plus* the nutriment which it has absorbed, it is probable that the adult contains neither in form, nor in substance, more than an inappreciable fraction of the constituents of the germ, and that it is almost, if not wholly, made up of assimilated and metamorphosed nutriment. In the great majority of cases, at any rate, the full-grown organism becomes what it is by the absorption of not-living matter, and its conversion into living matter of a specific type. As Harvey says (Ex. 45), all parts of the body are nourished "ab eodem succo alibili, aliter aliterque cambiato," "ut plantæ omnes ex eodem communi nutrimento (sive rore seu terræ humore)."

In all animals and plants above the lowest the germ is a nucleated cell, using that term in its broadest sense; and the first step in the process of the evolution of the individual is the division of this cell into two or more portions. The process of division is repeated, until the organism, from being unicellular, becomes multicellular. The single cell becomes a cell-aggregate; and it is to the growth and metamorphosis of the cells [201] of the cell-aggregate thus produced, that all the organs and tissues of the adult owe their origin.

In certain animals belonging to every one of the chief groups into which the *Metazoa* are divisible, the cells of the cell-aggregate which results from the process of yelk-division, and which is termed a

morula, diverge from one another in such a manner as to give rise to a central space, around which they dispose themselves as a coat or envelope; and thus the morula becomes a vehicle filled with fluid, the *planula.* The wall of the planula is next pushed in on one side, or invaginated, whereby it is converted into a double-walled sac with an opening, the *blastopore,* which leads into the cavity lined by the inner wall. This cavity is the primitive alimentary cavity or *archenteron;* the inner or invaginated layer is the *hypoblast;* the outer the *epiblast;* and the embryo, in this stage, is termed a *gastru1a.* In all the higher animals a layer of cells makes its appearance between the hypoblast and the epiblast, and is termed the *mesoblast.* In the further course of development the epiblast becomes the ectoderm or epidermic layer of the body; the hypoblast becomes the epithelium of the middle portion of the alimentary canal; and the mesoblast gives rise to all the other tissues, except the central nervous system, which originates from an ingrowth of the epiblast.

With more or less modification in detail, the [202] embryo has been observed to pass through these successive evolutional stages in sundry Sponges, Cœlenterates, Worms, Echinoderms, Tunicates, Arthropods, Mollusks, and Vertebrates; and there are valid reasons for the belief that all animals of higher organisation than the *Protozoa* agree in the general character of the early stages of their individual evolution. Each, starting from the condition of a simple nucleated cell, becomes a cell-aggregate; and this passes through a condition which represents the gastrula stage, before taking on the features distinctive of the group to which it belongs. Stated in this form, the "gastræa theory" of Haeckel appears to the present writer to be one of most important and best founded of recent generalisations. So far as individual plants and animals are concerned, therefore, evolution is not a speculation but a fact; and it takes place by epigenesis.

"Animal . . . per *epigenesin* procreatur, materiam simul attrahit, parat, concoquit, et eâdem utitur; formatur simul et augetur . . . primum futuri corporis concrementum . . . prout augetur, dividitur sensim et distinguitur in partes, non simul omnes, sed alias post alias natas, et ordine quasque suo emergentes."[16]

In these words, by the divination of genius, Harvey, in the seventeenth century, summed up the outcome of the work of all those who, with appliances he could not dream of, are continuing his labours in the nineteenth century.

[203] Nevertheless, though the doctrine of epigenesis, as understood by Harvey, has definitively triumphed over the doctrine of evolution, as understood by his opponents of the eighteenth century, it is not impossible that, when the analysis of the process of development is carried still further, and the origin of the molecular components of the physically gross, though sensibly minute, bodies which we term germs is traced, the theory of development will approach more nearly to metamorphosis than to epigenesis. Harvey thought that impregnation influenced the female organism as a contagion; and that the blood, which he conceived to be the first rudiment of the germ, arose in the clear fluid of the "colliquamentum" of the ovum by a process of concrescence, as a sort of living precipitate. We now know, on the contrary, that the female germ or ovum, in all the higher animals and plants, is a body which possesses the structure of a nucleated cell; that impregnation consists in the fusion of the substance[17] of another more or less modified nucleated cell, the male germ, with the ovum; and that the

structural components of the body of the embryo are all derived, by a process of division, from the coalesced male and female germs. Hence it is conceivable, and indeed probable, that every part of the adult contains molecules, derived both from the male and [204] from the female parent; and that, regarded as a mass of molecules, the entire organism may be compared to a web of which the warp is derived from the female and the woof from the male. And each of these may constitute one individuality, in the same sense as the whole organism is one individual, although the matter of the organism has been constantly changing. The primitive male and female molecules may play the part of Buffon's "moules organiques," and mould the assimilated nutriment, each according to its own type, into innumerable new molecules. From this point of view the process, which, in its superficial aspect, is epigenesis, appears in essence, to be evolution, in the modified sense adopted in Bonnet's later writings; and development is merely the expansion of a potential organism or "original preformation" according to fixed laws.

II. *The Evolution of the Sum of Living Beings.*

The notion that all the kinds of animals and plants may have come into existence by the growth and modification of primordial germs is as old as speculative thought; but the modern scientific form of the doctrine can be traced historically to the influence of several converging lines of philosophical speculation and of physical observation, none of which go farther back than the seventeenth century. These are:–

[205] 1. The enunciation by Descartes of the conception that the physical universe, whether living or not living, is a mechanism, and that, as such, it is explicable on physical principles.

2. The observation of the gradations of structure, from extreme simplicity to very great complexity, presented by living things, and of the relation of these graduated forms to one another.

3. The observation of the existence of an analogy between the series of gradations presented by the species which compose any great group of animals or plants, and the series of embryonic conditions of the highest members of that group.

4. The observation that large groups of species of widely different habits present the same fundamental plan of structure; and that parts of the same animal or plant, the functions of which are very different, likewise exhibit modifications of a common plan.

5. The observation of the existence of structures, in a rudimentary and apparently useless condition, in one species of a group, which are fully developed and have definite functions in other species of the same group.

6. The observation of the effects of varying conditions in modifying living organisms.

7. The observation of the facts of geographical distribution.

8. The observation of the facts of the geological succession of the forms of life.

[206] 1. Notwithstanding the elaborate disguise which fear of the powers that were led Descartes to throw over his real opinions, it is impossible to read the "Principes de la Philosophie" without acquiring the conviction that this great philosopher held that the physical world and all things in it, whether living or not living, have originated by a process of evolution, due to the continuous operation of purely physical causes, out of a primitive relatively formless matter.[18]

The following passage is especially instructive:–

"Et tant s'en faut que je veville que l'on croie toutes les choses que j'écrirai, que même je pretends en proposer ici quelques unes que je crois absolument être fausses; à savoir, je ne doute point que le monde n'ait été créé au commencement avec autant de perfection qu'il en a; en sorte que le soleil, la terre, la lune, et les étoiles ont été dès lors; et que la terre n'a pas eu seulement en soi les semences des plantes, mais que les plantes même en ont couvert une partie; et qu' Adam et Eve n'ont pas été créés enfans mais en âge d'hommes parfaits. La religion chrétienne veut que nous le croyons ainsi, et la raison naturelle nous persuade entièrement cette vérité; car si nous considérons la toute puissance de Dieu, nous devons juger que tout ce qu'il a fait a eu dès le commencement toute la perfection qu'il devoit avoir. Mais néanmoins, comme on connôitroit beaucoup mieux quelle a été la nature d'Adam et celle des arbres de Paradis si on avoit examiné comment les enfants se forment peu à peu dans le ventre de leurs mères et comment les plantes sortent de leurs semences, que si on avoit seulement considéré quels ils ont été quand Dieu les a créés: tout de même, nous ferons mieux entendre quelle est [207] généralement la nature de toutes les choses qui sont au monde si nous pouvons imaginer quelques principes qui soient fort intelligibles et fort simples, desquels nous puissions voir clairement que les astres et la terre et enfin tout ce monde visible auroit pu être produit ainsi que de quelques semences (bien que nous sachions qu'il n'a pas été produit en cette façon) que si nous la decrivions seulement comme il est, ou bien comme nous croyons qu'il a été créé. Et parceque je pense avoir trouvé des principes qui sont tels, je tacherai ici de les expliquer."[19]

If we read between the lines of this singular exhibition of force of one kind and weakness of another, it is clear that Descartes believed that he had divined the mode in which the physical universe had been evolved; and the "Traité de l'Homme," and the essay "Sur les Passions" afford abundant additional evidence that he sought for, and thought he had found, an explanation of the phenomena of physical life by deduction from purely physical laws.

Spinoza abounds in the same sense, and is as usual perfectly candid.

"Naturæ leges et regulæ, secundum quas omnia fiunt et ex unis formis in alias mutantur, sunt ubique et semper eadem."[20]

Leibnitz's doctrine of continuity necessarily led him in the same direction; and, of the infinite multitude of monads with which he peopled the world, each is supposed to be the focus of an endless process of evolution and involution. In the [208] "Protogæa," xxvi., Leibnitz distinctly suggests the mutability of species–

"Alii mirantur in saxis passim species videri quas vel in orbe cognito, vel saltem in vicinis locis frustra quæras. 'Ita Cornua Ammonis,' quæ ex nautilorum numero habeantur, passim et forma et magnitudine (nam et pedali diametro aliquando reperiuntur) ab omnibus illis naturis discrepare dicunt, quas præbet mare. Sed quis absconditos ejus recessus aut subterraneas abyssos pervestigavit? quam multa nobis animalia antea ignota offert novus orbis? Et credibile est per magnas illas conversiones etiam animalium species plurimum immutatas."

Thus, in the end of the seventeenth century, the seed was sown which has, at intervals, brought forth recurrent crops of evolutional hypotheses, based, more or less completely, on general reasonings.

Among the earliest of these speculations is that put forward by Benoit de Maillet in his "Telliamed," which,though printed in 1735, was not published until twenty-three years later. Considering that this book was written before the time of Haller, or Bonnet, or Linnæus, or Hutton, it surely deserves more respectful consideration than it usually receives. For De Maillet not only has a definite conception of the plasticity of living things, and of the production of existing species by the modification of their predecessors; but he clearly apprehends the cardinal maxim of modern geological science, that the explanation of the structure of the globe is to be sought in the [209] deductive application to geological phenomena of the principles established inductively by the study of the present course of nature. Somewhat later, Maupertuis[21] suggested a curious hypothesis as to the causes of variation, which he thinks may be sufficient to account for the origin of all animals from a single pair. Robinet[22] followed out much the same line of thought as De Maillet, but less soberly; and Bonnet's speculations in the "Palingénésie," which appeared in 1769, have already been mentioned. Buffon (1753-1778), at first a partisan of the absolute immutability of species, subsequently appears to have believed that larger or smaller groups of species have been produced by the modification of a primitive stock; but he contributed nothing to the general doctrine of evolution.

Erasmus Darwin ("Zoonomia," 1794), though a zealous evolutionist, can hardly be said to have made any real advance on his predecessors; and, notwithstanding that Goethe (1791-4) had the advantage of a wide knowledge of morphological facts, and a true insight into their signification, while he threw all the power of a great poet into the expression of his conceptions, it may be questioned whether he supplied the doctrine of evolu[210]tion with a firmer scientific basis than it already possessed. Moreover, whatever the value of Goethe's labours in that field, they were not published before 1820, long after evolutionism had taken a new departure from the works of Treviranus and Lamarck–the first of its advocates who were equipped for their task with the needful large and accurate knowledge of the phenomena of life, as a whole. It is remarkable that each of these writers seems to have been led, independently and contemporaneously, to invent the same name of "Biology" for the science of the phenomena of life; and thus, following Buffon, to have recognised the essential unity of these phenomena, and their contradistinction from those of inanimate nature. And it is hard to say whether Lamarck or Treviranus has the priority in propounding the main thesis of the doctrine of evolution; for though the first volume of Treviranus's "Biologie" appeared only in 1802, he says, in the preface to his later work, the "Erscheinungen und Gesetze des organischen Lebens," dated 1831, that he wrote the first volume of the "Biologie" "nearly five-and-thirty years ago," or about 1796.

Now, in 1794, there is evidence that Lamarck held doctrines which present a striking contrast to those which are to be found in the "Philosophie Zoologique," as the following passages show:–

"685. Quoique mon unique objet dans cet article n'ait été que de traiter de la cause physique de l'entretien de la vie des êtres [211] organiques, malgré cela j'ai osé avancer en débutant, que l'existence de ces êtres étonnants n'appartiennent nullement à la nature; que tout ce qu'on peut entendre par le mot *nature*, ne pouvoit donner la vie, c'est-à-dire, que toutes les qualités de la matière, jointes à toutes les circonstances possibles, et même à l'activité répandue dans l'univers, ne pouvaient point produire un être muni du mouvement organique, capable de reproduire son semblable, et sujet à la mort.

"686. Tous les individus de cette nature, qui existent, proviennent d'individus semblables qui tous ensemble constituent l'espèce entière. Or, je crois qu'il est aussi impossible à l'homme de connôitre la cause physique du premier individu de chaque espèce, que d'assigner aussi physiquement la cause de l'existence de la matière ou de l'univers entier. C'est au moins ce que le resultat de mes connaissances et de mes réflexions me portent à penser. S'il existe beaucoup de variétés produites par l'effet des circonstances, ces variétés ne dénaturent point les espèces; mais on se trompe, sans doute souvent, en indiquant comme espèce, ce qui n'est que variété; et alors je sens que cette erreur peut tirer à conséquence dans les raisonnements que l'on fait sur cette matière."[23]

The first three volumes of Treviranus's "Biologie," which contain his general views of evolution, appeared between 1802 and 1805. The "Recherches sur 1'organisation des corps vivants," in which the outlines of Lamarck's doctrines are given, was published in 1802; but the full develop[212]ment of his views, in the "Philosophie Zoologique," did not take place until 1809.

The "Biologie" and the "Philosophie Zoologique" are both very remarkable productions, and are still worthy of attentive study, but they fell upon evil times. The vast authority of Cuvier was employed in support of the traditionally respectable hypotheses of special creation and of catastrophism; and the wild speculations of the "Discours sur les Révolutions de la Surface du Globe" were held to be models of solid scientific thinking, while the really much more sober and philosophical hypotheses of the "Hydrogeologie" were scouted. For many years it was the fashion to speak of Lamarck with ridicule, while Treviranus was altogether ignored.

Nevertheless, the work had been done. The conception of evolution was henceforward irrepressible, and it incessantly reappears, in one shape or another,[24] up to the year 1858, when Mr. Darwin and Mr. Wallace published their "Theory of Natural Selection." The "Origin of Species" appeared in 1859; and it is within the knowledge of all whose memories go back to that time, that, henceforward, the doctrine of evolution has assumed a position and acquired an importance which it never before possessed. In the "Origin of Species," and in his other numerous and [213] important contributions to the solution of the problem of biological evolution, Mr. Darwin confines himself to the discussion of the causes which have brought about the present condition of living matter, assuming such matter to have once come into existence. On the other hand, Mr. Spencer[25] and Professor Haeckel[26] have dealt with the whole problem of evolution. The profound and vigorous writings of Mr. Spencer embody the spirit of Descartes in the knowledge of our own day, and may be regarded as the "Principes de la Philosophie" of the nineteenth

century; while, whatever hesitation may not unfrequently be felt by less daring minds, in following Haeckel in many of his speculations, his attempt to systematise the doctrine of evolution and to exhibit its influence as the central thought of modern biology, cannot fail to have a far-reaching influence on the progress of science.

If we seek for the reason of the difference between the scientific position of the doctrine of evolution a century ago, and that which it occupies now, we shall find it in the great accumulation of facts, the several classes of which have been enumerated above, under the second to the eighth heads. For those which are grouped under the second to the seventh of these classes, respectively, have a clear significance on the hypothesis of [214] evolution, while they are unintelligible if that hypothesis be denied. And those of the eighth group are not only unintelligible without the assumption of evolution, but can be proved never to be discordant with that hypothesis, while, in some cases, they are exactly such as the hypothesis requires. The demonstration of these assertions would require a volume, but the general nature of the evidence on which they rest may be briefly indicated.

2. The accurate investigation of the lowest forms of animal life, commenced by Leeuwenhoek and Swammerdam, and continued by the remarkable labours of Reaumur, Trembley, Bonnet, and a host of other observers, in the latter part of the seventeenth and the first half of the eighteenth centuries, drew the attention of biologists to the gradation in the complexity of organisation which is presented by living beings, and culminated in the doctrine of the "échelle des êtres," so powerfully and clearly stated by Bonnet; and, before him, adumbrated by Locke and by Leibnitz. In the then state of knowledge, it appeared that all the species of animals and plants could be arranged in one series; in such a manner that, by insensible gradations, the mineral passed into the plant, the plant into the polype, the polype into the worm, and so, through gradually higher forms of life, to man, at the summit of the animated world.

[215] But, as knowledge advanced, this conception ceased to be tenable in the crude form in which it was first put forward. Taking into account existing animals and plants alone, it became obvious that they fell into groups which were more or less sharply separated from one another; and, moreover, that even the species of a genus can hardly ever be arranged in linear series. Their natural resemblances and differences are only to be expressed by disposing them as if they were branches springing from a common hypothetical centre.

Lamarck, while affirming the verbal proposition that animals form a single series, was forced by his vast acquaintance with the details of zoology to limit the assertion to such a series as may be formed out of the abstractions constituted by the common characters of each group.[27]

Cuvier on anatomical, and Von Baer on embryological grounds, made the further step of proving that, even in this limited sense, animals cannot be arranged in a single series, but that there are several distinct plans of organisation to be observed among them, no one of which, in its highest and most complicated modification, leads to any of the others.

[216] The conclusions enunciated by Cuvier and Von Baer have been confirmed, in principle, by all

subsequent research into the structure of animals and plants. But the effect of the adoption of these conclusions has been rather to substitute a new metaphor for that of Bonnet than to abolish the conception expressed by it. Instead of regarding living things as capable of arrangement in one series like the steps of a ladder, the results of modern investigation compel us to dispose them as if they were the twigs and branches of a tree. The ends of the twigs represent individuals, the smallest groups of twigs species, larger groups genera, and so on, until we arrive at the source of all these ramifications of the main branch, which is represented by a common plan of structure. At the present moment, it is impossible to draw up any definition, based on broad anatomical or developmental characters, by which any one of Cuvier's great groups shall be separated from all the rest. On the contrary, the lower members of each tend to converge towards the lower members of all the others. The same may be said of the vegetable world. The apparently clear distinction between flowering and flowerless plants has been broken down by the series of gradations between the two exhibited by the *Lycopodiaceæ, Rhizocarpeæ*, and *Gymnospermeæ*. The groups of *Fungi*, *Lichenes*, and *Algæ* have completely run into one another, and, when the lowest forms of each are [217] alone considered, even the animal and vegetable kingdoms cease to have a definite frontier.

If it is permissible to speak of the relations of living forms to one another metaphorically, the similitude chosen must undoubtedly be that of a common root, whence two main trunks, one representing the vegetable and one the animal world, spring; and, each dividing into a few main branches, these subdivide into multitudes of branchlets and these into smaller groups of twigs.

As Lamarck has well said–[28]

"II n'y a que ceux qui se sont longtemps et fortement occupés de la détermination des espèces, et qui ont consulté de riches collections, qui peuvent savoir jusqu'à quel point les *espèces*,parmi les corps vivants se fondent les unes dans les autres, et qui ont pu se convaincre que, dans les parties où nous voyons des *espèces* isolès, cela n'est ainsi que parcequ'il nous en manque d'autres qui en sont plus voisines et que nous n'avons pas encore recueillies.

"Je ne veux pas dire pour cela que les animaux qui existent forment une série très-simple et partout également nuancée; mais je dis qu'ils forment une série ramense, irréguliérement graduée et qui n'a point de discontinuité dans ses parties, ou qui, du moins, n'en a toujours pas eu, s'il est vrai que, par suite de quelques espèces perdues, il s'en trouve quelque part. Il en resulte que les *espèces* qui terminent chaque rameau de la série générale tiennent, au moins d'un côté, à d'autres espèces voisines qui se nuancent avec elles. Voilà ce que l'état bien connu des choses me met maintenant à portée de demontrer. Je n'ai besoin d'aucune hypothèse ni d'aucune supposition pour cela: j'en atteste tous les naturalistes observateurs."

[218] In a remarkable essay[29] Meckel remarks–

"There is no good physiologist who has not been struck by the observation that the original form of all organisms is one and the same, and that out of this one form, all, the lowest as well as the highest, are developed in such a manner that the latter pass through the permanent forms of the former as transitory stages. Aristotle, Haller, Harvey, Kielmeyer, Autenrieth, and many others, have either made this observation incidentally, or, especially the latter, have drawn particular attention to it, and deduced therefrom results of permanent importance for

physiology."

Meckel proceeds to exemplify the thesis, that the lower forms of animals represent stages in the course of the development of the higher, with a large series of illustrations.

After comparing the Salamanders and the perennibranchiate *Urodela* with the Tadpoles and the Frogs, and enunciating the law that the more highly any animal is organised the more quickly does it pass through the lower stages, Meckel goes on to say–

"From these lowest Vertebrata to the highest, and to the highest forms among these, the comparison between the embryonic conditions of the higher animals and the adult states of the lower can be more completely and thoroughly instituted than if the survey is extended to the Invertebrata, inasmuch as the latter are in many respects constructed upon an altogether too dissimilar type; indeed they often differ from one another far more than the lowest vertebrate does from the highest mammal; yet the [219] following pages will show that the comparison may also be extended to them with interest. In fact, there is a period when, as Aristotle long ago said, the embryo of the highest animal has the form of a mere worm; and, devoid of internal and external organisation, is merely an almost structureless lump of polype substance. Notwithstanding the origin of organs, it still for a certain time, by reason of its want of an internal bony skeleton, remains worm and mollusk, and only later enters into the series of the Vertebrata, although traces of the vertebral column even in the earliest periods testify its claim to a place in that series."–*Op. cit.* pp. 4, 5.

If Meckel's proposition is so far qualified, that the comparison of adult with embryonic forms is restricted within the limits of one type of organisation; and, if it is further recollected that the resemblance between the permanent lower form and the embryonic stage of a higher form is not special but general, it is in entire accordance with modern embryology; although there is no branch of biology which has grown so largely, and improved its methods so much, since Meckel's time, as this. In its original form, the doctrine of "arrest of development," as advocated by Geoffroy Saint-Hilaire and Serres, was no doubt an overstatement of the case. It is not true, for example, that a fish is a reptile arrested in its development, or that a reptile was ever a fish: but it is true that the reptile embryo, at one stage of its development, is an organism which, if it had an independent existence, must be classified among fishes; and all the organs of the reptile pass, in the course of their development, through conditions [220] which are closely analogous to those which are permanent in some fishes.

4. That branch of biology which is termed Morphology is a commentary upon, and expansion of, the proposition that widely different animals or plants, and widely different parts of animals or plants, are constructed upon the same plan. From the rough comparison of the skeleton of a bird with that of a man by Belon, in the sixteenth century (to go no farther back), down to the theory of the limbs and the theory of the skull at the present day; or, from the first demonstration of the homologies of the parts of a flower by C. F. Wolff, to the present elaborate analysis of the floral organs, morphology exhibits a continual advance towards the demonstration of a fundamental unity among the seeming diversities of living structures. And this demonstration has been completed by the final establishment of the cell theory, which involves the admission of a primitive conformity, not only of all the elementary structures in animals and plants respectively, but of those in the one of these great divisions of living things with

those in the other. No *a priori* difficulty can be said to stand in the way of evolution, when it can be shown that all animals and all plants proceed by modes of development, which are similar in principle, from a fundamental protoplasmic material.

5. The innumerable cases of structures, which are [221] rudimentary and apparently useless, in species, the close allies of which possess well-developed and functionally important homologous structures, are readily intelligible on the theory of evolution, while it is hard to conceive their *raison d'être* on any other hypothesis. However, a cautious reasoner will probably rather explain such cases deductively from the doctrine of evolution than endeavour to support the doctrine of evolution by them. For it is almost impossible to prove that any structure, however rudimentary, is useless–that is to say, that it plays no part whatever in the economy; and, if it is in the slightest degree useful, there is no reason why, on the hypothesis of direct creation, it should not have been created. Nevertheless, double-edged as is the argument from rudimentary organs, there is probably none which has produced a greater effect in promoting the general acceptance of the theory of evolution.

6. The older advocates of evolution sought for the causes of the process exclusively in the influence of varying conditions, such as climate and station, or hybridisation, upon living forms. Even Treviranus has got no farther than this point. Lamarck introduced the conception of the action of an animal on itself as a factor in producing modification. Starting from the well-known fact that the habitual use of a limb tends to develop the muscles of the limb, and to produce a greater and greater [222] facility in using it, he made the general assumption that the effort of an animal to exert an organ in a given direction tends to develop the organ in that direction. But a little consideration showed that, though Lamarck had seized what, as far it goes, is a true cause of modification, it is a cause the actual effects of which are wholly inadequate to account for any considerable modification in animals, and which can have no influence at all in the vegetable world; and probably nothing contributed so much to discredit evolution, in the early part of this century, as the floods of easy ridicule which were poured upon this part of Lamarck's speculation. The theory of natural selection, or survival of the fittest, was suggested by Wells in 1813, and further elaborated by Matthew in 1831. But the pregnant suggestions of these writers remained practically unnoticed and forgotten, until the theory was independently devised and promulgated by Darwin and Wallace in 1858, and the effect of its publication was immediate and profound.

Those who were unwilling to accept evolution, without better grounds than such as are offered by Lamarck, or the author of that particularly unsatisfactory book, the "Vestiges of the Natural History of the Creation," and who therefore preferred to suspend their judgment on the question, found, in the principle of selective breeding, pursued in all its applications with marvellous knowledge and skill by Mr. Darwin, a [223] valid explanation of the occurrence of varieties and races; and they saw clearly that, if the explanation would apply to species, it would not only solve the problem of their evolution, but that it would account for the facts of teleology, as well as for those of morphology; and for the persistence of some forms of life unchanged through long epochs of time, while others undergo comparatively rapid metamorphosis.

How far "natural selection" suffices for the production of species remains to be seen. Few can doubt that, if not the whole cause, it is a very important factor in that operation; and that it must play a great

part in the sorting out of varieties into those which are transitory and those which are permanent.

But the causes and conditions of variation have yet to be thoroughly explored; and the importance of natural selection will not be impaired, even if further inquiries should prove that variabilitv is definite, and is determined in certain directions rather than in others, by conditions inherent in that which varies. It is quite conceivable that every species tends to produce varieties of a limited number and kind, and that the effect of natural selection is to favour the development of some of these, while it opposes the development of others along their predetermined lines of modification.

7. No truths brought to light by biological [224] investigation were better calculated to inspire distrust of the dogmas intruded upon science in the name of theology, than those which relate to the distribution of animals and plants on the surface of the earth. Very skilful accommodation was needful, if the limitation of sloths to South America, and of the ornithorhynchus to Australia, was to be reconciled with the literal interpretation of the history of the deluge; and with the establishment of the existence of distinct provinces of distribution, any serious belief in the peopling of the world by migration from Mount Ararat came to an end.

Under these circumstances, only one alternative was left for those who denied the occurrence of evolution–namely, the supposition that the characteristic animals and plants of each great province were created as such, within the limits in which we find them. And as the hypothesis of "specific centres," thus formulated, was heterodox from the theological point of view, and unintelligible under its scientific aspect, it may be passed over without further notice, as a phase of transition from the creational to the evolutional hypothesis.

8. In fact, the strongest and most conclusive arguments in favour of evolution are those which are based upon the facts of geographical, taken in conjunction with those of geological, distribution.

[225] Both Mr. Darwin and Mr. Wallace lay great stress on the close relation which obtains between the existing fauna of any region and that of the immediately antecedent geological epoch in the same region; and rightly, for it is in truth inconceivable that there should be no genetic connection between the two. It is possible to put into words the proposition that all the animals and plants of each geological epoch were annihilated and that a new set of very similar forms was created for the next epoch; but it may be doubted if any one who ever tried to form a distinct mental image of this process of spontaneous generation on the grandest scale, ever really succeeded in realising it.

Within the last twenty years, the attention of the best palæontologists has been withdrawn from the hodman's work of making "new species" of fossils, to the scientific task of completing our knowledge of individual species, and tracing out the succession of the forms presented by any given type in time.

Those who desire to inform themselves of the nature and extent of the evidence bearing on these questions may consult the works of Rütimeyer, Gaudry, Kowalewsky, Marsh, and the writer of the present article. It must suffice, in this place, to say that the successive forms of the Equine type have

been fully worked out; while those of nearly all the other existing types of Ungulate mammals [226] and of the *Carnivora* have been almost as closely followed through the Tertiary deposits; the gradations between birds and reptiles have been traced; and the modifications undergone by the *Crocodilia,* from the Triassic epoch to the present day, have been demonstrated. On the evidence of palæontology, the evolution of many existing forms of animal life from their predecessors is no longer an hypothesis, but an historical fact; it is only the nature of the physiological factors to which that evolution is due which is still open to discussion.

[At page 209, the reference to Erasmus Darwin does not do justice to that ingenious writer, who, in the 39th section of the *Zoonomia,* clearly and repeatedly enunciates the theory of the inheritance of acquired modifications. For example: "From their first rudiment, or primordium, to the termination of their lives, all animals undergo perpetual transformations; which are in part produced by their own exertions in consequence of their desires and aversions, of their pleasures and their pains, or of irritation, or of associations; and many of these acquired forms or propensities are transmitted to their posterity." *Zoonomia* I., p. 506. 1893.]

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[1] The *Exercitationes de Generatione Animalium,* which Dr. George Ent extracted from him and published in 1651.

[2] *De Generatione Animalium,* lib.ii. cap. x.

[3] *De Generatione,* lib. ii. cap. iv.

[4] "Cependant, pour revenir aux formes ordinaires, ou aux âmes matérielles, cette durée qu'il leur faut attribuer à la place de celle qu'on avoit attribuée aux atomes pourroit faire douter si elles ne vont pas de corps en corps; ce qui seroit la métempsychose, à peu près comme quelques philosophes ont cru la transmission du mouvement et celle des espèces. Mais cette imagination est bien éloignée de la nature des choses. II n'y a point de tel passage, et c'est ici où les transformations de Messieurs Swammerdam, Malpighi, et Leewenhoek, qui sont des plus excellens observateurs de notre tems, sont venues à mon secours, et m'ont fait admettre plus aisément, que l'animal, et toute autre substance organisée ne commence point lorsque nous le croyons, et que sa generation apparente n'est qu'une développement et une espèce d'augmentation. Aussi ai je remarqué que l'auteur de la *Recherche da la Verité,* M. Regis, M. Hartsoeker, et d'autres habiles hommes n'ont pas été fort éloignés de ce sentiment." Leibnitz, *Système Nouveau de la Nature,* 1695. The doctrine of "Emboîtement" is contained in the *Considerations sur le Principe de Vie,* 1705, the preface to the *Theodicée* 1710, and the *Principes de la Nature et da la Grace* (§ 6), 1718.

[5] II est vrai que la pensée la plus raisonnable et la plus conforme à l'experience sur cette question très difficile de la formation du fœtus; c'est que les enfans sont déja presque tout formés avant même l'action par laquelle ils sont conçus; et que leurs mères ne font que leur donner l'accroissement ordinaire dans le temps de la grossesse." *De la Recherche de la Verité* livre ii. chap. vii. p. 334, 7th ed., 1721.

[6] The writer is indebted to Dr. Allen Thomson for reference to the evidence contained in a note to Haller's edition of Boerhaave's *Prælectiones Academicæ*, vol. v. pt. ii. p. 497, published in 1744, that Haller originally advocated epigenesis.

[7] *Considérations sur les Corps organisés*, chap. x.

[8] Bonnet had the courage of his opinions, and in the *Palingénésie Philosophique*, part vi. chap. iv., he develops a hypothesis which he terms "évolution naturelle;" and which, making allowance for his peculiar vievs of the nature of generation, bears no small resemblance to what is understood by "evolution" at the present day:–

"Si la volonté divine a créé par un seul Acte l'Universalité des êtres, d'où venoient ces plantes et ces animaux dont Moyse nous decrit la Production au troisieme et au cinquieme jour du renouvellement de notre monde?

"Abuserois-je de la liberté de conjectures si je disois, que les Plantes et les Animaux qui existent aujourd'hui sont parvenus par une sorte d'evolution naturelle des Etres organisés qui peuplaient ce premier Monde, sorti immédiatement des Mains du Createur? ...

"Ne supposons que trois révolutions. La Terre vient de sortir des Mains du Createur. Des causes preparées par sa Sagesse font développer de toutes parts les Germes. Les Etres organisés commencent à jouir de l'existence. Ils l'etoient probablement alors bien différens de ce qu'ils sont aujourd'hui. Ils l'etoient autent que ce primere Monde différoit de celui que nous habitons. Nous manquons de moyens pour juger de ces dissemblances, et peut-être que le plus habile Naturaliste qui auroit été placé dans ce premier Monde y auroit entièrement méconnu nos Plantes et nos Animaux."

[9] "Ce mot (germe) ne désignera pas seulement un corps organisé *réduit en petit;* il désignera encore toute espèce de *préformation originelle dont un Tout organique peut résulter comme de son principe immédiat.*"–*Palingénésie Philosophique*, part x. chap. ii.

[10] "M. Cuvier considérant que tous les êtres organisés sont dérivés de parens, et ne voyant dans la nature aucune force capable de produire l'organisation, croyait à la pré-existence des germes; non pas à la pré-existence d'un être tout formé, puisqu'il est bien évident que ce n'est que par des développemens successifs que l'être acquiert sa forme; mais, si l'on peut s'exprimer ainsi, à la pré-existence du *radical de l'être*, radical qui existe avant que la série des évolutions ne commence, et qui remonte certainement, suivant la belle observation de Bonnet, à plusieurs generations."–Laurillard, *Eloge de Cuvier*, note 12.

[11] *Histoire Naturelle*, tom. ii. ed. ii. 1750, p. 350.

[12] *Ibid.*, p. 351.

[13] See particularly Buffon, *l.c.* p. 4l.

[14] *Exercitationes de Generatione.* Ex. 62, "Ovum esse primordium commune omnibus animalibus."

[15] In some cases of sexless multiplication the germ is a cell-aggregate–if we call germ only that which is already detached from the parent organism.

[16] Harvey, *Exercitationes de Generatione.* Ex. 45, "Quænam sit pulli materia et quomodo fiat in Ovo."

[17] [At any rate of the nuclei of the two germ-cells. 1893].

[18] As Buffon has well said:–"L'idée de ramener l'explication de tous les phénomènes à des principes mecaniques est assurement grande et belle, ce pas est le plus hardi qu'on peut faire en philosophie, et c'est Descartes qui l'a fait."–*l. c.*, p. 50.

[19] *Principes de la Philosophie*, Troisième partie, § 45.

[20] *Ethices*, Pars tertia, Præfatio.

[21] *Système de la Nature.* "Essai sur la Formation des Corps Organisés," 1751, xiv.

[22] *Considérations Philosophiques sur la gradation naturelle des formes de l'être; ou les essais de la nature qui apprend à faire l'homme*, 1768.

[23] *Recherches sur les causes des principaux faits physiques*, par J. R. Lamarck. Paris. Seconde année de la République. In the preface, Lamarck says that the work was written in 1776, and presented to the Academy in 1780; but it was not published before 1794, and, at that time, it presumably expressed Lamarck's mature views. It would be interesting to know what brought about the change of opinion manifested in the *Recherches sur l'organisation des corps vivants*, published only seven years later.

[24] See the "Historical Sketch" prefixed to the last edition of the *Origin of Species.*

[25] *First Principles* and *Principles of Biology*, 1860-1864.

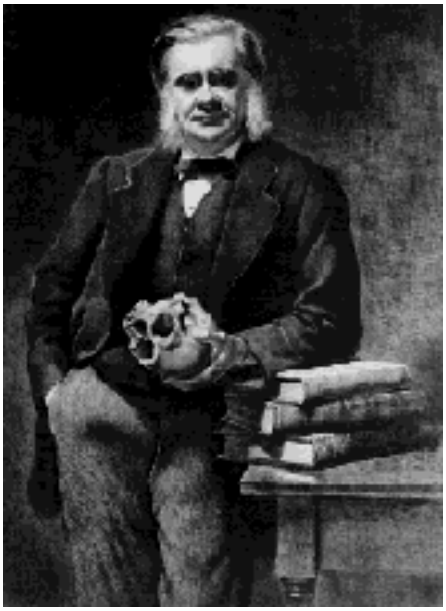
[26] *Generelle Morphologie*, 1866.

[27] "Il s'agit donc de prouver que la série qui constitue l'échelle animale réside essentiellement dans la distribution des masses principales qui la composent et non dans celle des espèces ni même toujours dans celle des genres."–*Philosophie Zoologique*, chap. v.

[28] *Philosophie Zoologique*, première partie, chap. iii.

[29] "Entwurf einer Darstellung der zwischen dem Embryozustände der höheren Thiere und dem permanenten der niederen stattfindenden Parallele," *Beyträge zur Vergleichenden Anatomie*, Bd. ii. 1811.

THE HUXLEY FILE



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The Coming of Age of "The Origin of Species" (1880)

Collected Essays II

[227] Many of you will be familiar with the aspect of this small green-covered book. It is a copy of the first edition of the "Origin of Species," and bears the date of its production–the 1st of October 1859. Only a few months, therefore, are needed to complete the full tale of twenty-one years since its birthday.

Those whose memories carry them back to this time will remember that the infant was remarkably lively, and that a great number of excellent persons mistook its manifestations of a vigorous individuality for mere naughtiness; in fact there was a very pretty turmoil about its cradle. My recollections of the period are particularly vivid; for, having conceived a tender affection for a child of what appeared to me to be such remarkable promise, I acted for some time in the capacity of a [228] sort of under-nurse, and thus came in for my share of the storms which threatened the very life of the young creature. For some years it was undoubtedly warm work; but considering how exceedingly unpleasant the apparition of the newcomer must have been to those who did not fall in love with him at first sight, I think it is to the credit of our age that the war was not fiercer, and that the more bitter and unscrupulous forms of opposition died away as soon as they did.

I speak of this period as of something past and gone, possessing merely an historical, I had almost said an antiquarian interest. For, during the second decade of the existence of the "Origin of Species," opposition, though by no means dead, assumed a different aspect. On the part of all those who had any reason to respect themselves, it assumed a thoroughly respectful character. By this time, the dullest began to perceive that the child was not likely to perish of any congenital weakness or infantile disorder, but was growing into a stalwart personage, upon whom mere goody scoldings and threatenings with the birch-rod were quite thrown away.

In fact, those who have watched the progress of science within the last ten years will bear me out to the full, when I assert that there is no field of biological inquiry in which the influence of the "Origin of Species" is not traceable; the foremost men of science in every country are either avowed [229] champions of its leading doctrines, or at any rate abstain from opposing them; a host of young and ardent investigators seek for and find inspiration and guidance in Mr. Darwin's great work; and the general doctrine of evolution, to one side of which it gives expression, obtains, in the phenomena of biology, a firm base of operations whence it may conduct its conquest of the whole realm of Nature.

History warns us, however, that it is the customary fate of new truths to begin as heresies and to end as superstitions; and, as matters now stand, it is hardly rash to anticipate that, in another twenty years, the new generation, educated under the influences of the present day, will be in danger of accepting the main doctrines of the "Origin of Species," with as little reflection, and it may be with as little justification, as so many of our contemporaries, twenty years ago, rejected them.

Against any such a consummation let us all devoutly pray; for the scientific spirit is of more value than its products, and rationally held truths may be more harmful than reasoned errors. Now the essence of the scientific spirit is criticism. It tells us that whenever a doctrine claims our assent we should reply, Take it if you can compel it. The struggle for existence holds as much in the intellectual as in the physical world. A theory is a species of thinking, and its right to exist is coextensive with its power of resisting extinction by its rivals.

[230] From this point of view, it appears to me that it would be but a poor way of celebrating the Coming of Age of the "Origin of Species," were I merely to dwell upon the facts, undoubted and remarkable as they are, of its far-reaching influence and of the great following of ardent disciples who are occupied in spreading and developing its doctrines. Mere insanities and inanities have before now swollen to portentous size in the course of twenty years. Let us rather ask this prodigious change in opinion to justify itself: let us inquire whether anything has happened since 1859, which will explain, on rational grounds, why so many are worshipping that which they burned, and burning that which they worshipped. It is only in this way that we shall acquire the means of judging whether the movement we have witnessed is a mere eddy of fashion, or truly one with the irreversible current of intellectual progress, and, like it, safe from retrogressive reaction.

Every belief is the product of two factors: the first is the state of the mind to which the evidence in favour of that belief is presented; and the second is the logical cogency of the evidence itself. In both these respects, the history of biological science during the last twenty years appears to me to afford an ample explanation of the change which has taken place; and a brief consideration of the salient events of that history will enable us to understand why, if the "Origin of Species" ap[231]peared now, it would meet with a very different reception from that which greeted it in 1859.

One-and-twenty years ago, in spite of the work commenced by Hutton and continued with rare skill and patience by Lyell, the dominant view of the past history of the earth was catastrophic. Great and sudden physical revolutions, wholesale creations and extinctions of living beings, were the ordinary machinery of the geological epic brought into fashion by the misapplied genius of Cuvier. It was gravely maintained and taught that the end of every geological epoch was signalised by a cataclysm, by which every living being on the globe was swept away, to be replaced by a brand-new creation when the world returned to quiescence. A scheme of nature which appeared to be modelled on the likeness of a succession of rubbers of whist, at the end of each of which the players upset the table and called for a new pack, did not seem to shock anybody.

I may be wrong, but I doubt if, at the present time, there is a single responsible representative of these opinions left. The progress of scientific geology has elevated the fundamental principle of uniformitarianism, that the explanation of the past is to be sought in the study of the present, into the position of an axiom; and the wild speculations of the catastrophists, to which we all listened with respect a quarter of a century ago, would hardly find a single patient hearer at the present [232] day. No physical geologist now dreams of seeking, outside the range of known natural causes, for the explanation of anything that happened millions of years ago, any more than he would be guilty of the like absurdity in regard to current events.

The effect of this change of opinion upon biological speculation is obvious. For, if there have been no periodical general physical catastrophes, what brought about the assumed general extinctions and re-creations of life which are the corresponding biological catastrophes? And, if no such interruptions of the ordinary course of nature have taken place in the organic, any more than in the inorganic, world, what alternative is there to the admission of evolution?

The doctrine of evolution in biology is the necessary result of the logical application of the principles of uniformitarianism to the phenomena of life. Darwin is the natural successor of Hutton and Lyell, and the "Origin of Species" the logical sequence of the "Principles of Geology."

The fundamental doctrine of the "Origin of Species," as of all forms of the theory of evolution applied to biology, is "that the innumerable species, genera, and families of organic beings with which the world is peopled have all descended, each within its own class or group, from common parents, and have all been modified in the course of descent."[1]

[233] And, in view of the facts of geology, it follows that all living animals and plants "are the lineal descendants of those which lived long before the Silurian epoch."[2]

It is an obvious consequence of this theory of descent with modification, as it is sometimes called, that all plants and animals, however different they may now be, must, at one time or other, have been connected by direct or indirect intermediate gradations, and that the appearance of isolation presented by various groups of organic beings must be unreal.

No part of Mr. Darwin's work ran more directly counter to the prepossessions of naturalists twenty years ago than this. And such prepossessions were very excusable, for there was undoubtedly a great deal to be said, at that time, in favour of the fixity of species and of the existence of great breaks, which there was no obvious or probable means of filling up, between various groups of organic beings.

For various reasons, scientific and unscientific, much had been made of the hiatus between man and the rest of the higher mammalia, and it is no wonder that issue was first joined on this part of the controversy. I have no wish to revive past and happily forgotten controversies; but I must state the simple fact that the distinctions in the cerebral and other characters, which were so hotly affirmed to separate man from all other animals in 1860, have all been demonstrated to be non-[234]existent, and that the contrary doctrine is now universally accepted and taught.

But there were other cases in which the wide structural gaps asserted to exist between one group of animals and another were by no means fictitious; and, when such structural breaks were real, Mr. Darwin could account for them only by supposing that the intermediate forms which once existed had become extinct. In a remarkable passage he says–

"We may thus account even for the distinctness of whole classes from each other–for instance, of birds from all other vertebrate animals–by the belief that many animal forms of life have been utterly lost, through which the early progenitors of birds were formerly connected with the early progenitors of the other vertebrate classes."[3]

Adverse criticism made merry over such suggestions as these. Of course it was easy to get out of the difficulty by supposing extinction; but where was the slightest evidence that such intermediate forms between birds and reptiles as the hypothesis required ever existed? And then probably followed a tirade upon this terrible forsaking of the paths of "Baconian induction."

But the progress of knowledge has justified Mr. Darwin to an extent which could hardly have been anticipated. In 1862, the specimen of *Archæopteryx*, which, until the last two or three [235] years, has remained unique, was discovered; and it is an animal which, in its feathers and the greater part of its organisation, is a veritable bird, while, in other parts, it is as distinctly reptilian.

In 1868, I had the honour of bringing, under your notice, in this theatre, the results of investigations made, up to that time, into the anatomical characters of certain ancient reptiles, which showed the nature of the modifications in virtue of which the type of the quadrupedal reptile passed into that of a bipedal bird; and abundant confirmatory evidence of the justice of the conclusions which I then laid before you has since come to light.

In 1875, the discovery of the toothed bird of the cretaceous formation in North America by Professor Marsh completed the series of transitional forms between birds and reptiles, and removed Mr. Darwin's proposition that "many animal forms of life have been utterly lost, through which the early progenitors of birds were formerly connected with the early progenitors of the other vertebrate classes," from the region of hypothesis to that of demonstrable fact.

In 1859, there appeared to be a very sharp and clear hiatus between vertebrated and invertebrated animals, not only in their structure, but, what was more important, in their development. I do not think that we even yet know the precise [236] links of connection between the two; but the investigations of Kowalewsky and others upon the development of *Amphioxus* and of the *Tunicata* prove, beyond a doubt, that the differences which were supposed to constitute a barrier between the two are non-existent. There is no longer any difficulty in understanding how the vertebrate type may have arisen from the invertebrate, though the full proof of the manner in which the transition was actually effected may still be lacking.

Again, in 1859, there appeared to be a no less sharp separation between the two great groups of flowering and flowerless plants. It is only subsequently that the series of remarkable investigations inaugurated by Hofmeister has brought to light the extraordinary and altogether unexpected modifications of the reproductive apparatus in the *Lycopodiaceæ*, the *Rhizocarpeæ* and the *Gymnospermeæ*, by which the ferns and the mosses are gradually connected with the Phanerogamic division of the vegetable world.

So, again, it is only since 1859 that we have acquired that wealth of knowledge of the lowest forms of life which demonstrates the futility of any attempt to separate the lowest plants from the lowest animals, and shows that the two kingdoms of living nature have a common borderland which belongs to both, or to neither.

Thus it will be observed that the whole ten[237]dency of biological investigation, since 1859, has been in the direction of removing the difficulties which the apparent breaks in the series created at that time; and the recognition of gradation is the first step towards the acceptance of evolution.

As another great factor in bringing about the change of opinion which has taken place among naturalists, I count the astonishing progress which has been made in the study of embryology. Twenty years ago, not only were we devoid of any accurate knowledge of the mode of development of many groups of animals and plants, but the methods of investigation were rude and imperfect. At the present time, there is no important group of organic beings the development of which has not been carefully studied; and the modern methods of hardening and section-making enable the embryologist to determine the nature of the process, in each case, with a degree of minuteness and accuracy which is truly astonishing to those whose memories carry them back to the beginnings of modern histology. And the results of these embryological investigations are in complete harmony with the requirements of the doctrine of evolution. The first beginnings of all the higher forms of animal life are similar, and however diverse their adult conditions, they start from a common foundation. Moreover, the process of development of the animal or the plant [238] from its primary egg, or germ, is a true process of evolution–a progress from almost formless to more or less highly organised matter, in virtue of the properties inherent in that matter.

To those who are familiar with the process of development, all *a priori* objections to the doctrine of biological evolution appear childish. Any one who has watched the gradual formation of a complicated animal from the protoplasmic mass, which constitutes the essential element of a frog's or a hen's egg, has had under his eyes sufficient evidence that a similar evolution of the whole animal world from the like foundation is, at any rate, possible.

Yet another product of investigation has largely contributed to the removal of the objections to the doctrine of evolution current in 1859. It is the proof afforded by successive discoveries that Mr. Darwin did not over-estimate the imperfection of the geological record. No more striking illustration of this is needed than a comparison of our knowledge of the mammalian fauna of the Tertiary epoch in 1859 with its present condition. M. Gaudry's researches on the fossils of Pikermi were published in 1868, those of Messrs. Leidy, Marsh, and Cope, on the fossils of the Western Territories of America, have appeared almost wholly since 1870, those of M. Filhol on the phosphorites of Quercy in 1878. The general effect of these investigations has been to intro[239]duce to us a multitude of extinct animals, the existence of which was previously hardly suspected; just as if zoologists were to become acquainted with a country, hitherto unknown, as rich in novel forms of life as Brazil or South Africa once were to Europeans. Indeed, the fossil fauna of the Western Territories of America bid fair to exceed in interest and importance all other known Tertiary deposits put together; and yet, with the exception of the case of the

American tertiaries, these investigations have extended over very limited areas; and, at Pikermi, were confined to an extremely small space.

Such appear to me to be the chief events in the history of the progress of knowledge during the last twenty years, which account for the changed feeling with which the doctrine of evolution is at present regarded by those who have followed the advance of biological science, in respect of those problems which bear indirectly upon that doctrine.

But all this remains mere secondary evidence. It may remove dissent, but it does not compel assent. Primary and direct evidence in favour of evolution can be furnished only by palæontology. The geological record, so soon as it approaches completeness, must, when properly questioned, yield either an affirmative or a negative answer: if evolution has taken place, there will its mark [240] be left; if it has not taken place, there will lie its refutation.

What was the state of matters in 1859? Let us hear Mr. Darwin, who may be trusted always to state the case against himself as strongly as possible.

"On this doctrine of the extermination of an infinitude of connecting links between the living and extinct inhabitants of the world, and at each successive period between the extinct and still older species, why is not every geological formation charged with such links? Why does not every collection of fossil remains afford plain evidence of the gradation and mutation of the forms of life? We meet with no such evidence, and this is the most obvious and plausible of the many objections which may be urged against my theory."[4]

Nothing could have been more useful to the opposition than this characteristically candid avowal, twisted as it immediately was into an admission that the writer's views were contradicted by the facts of palæontology. But, in fact, Mr. Darwin made no such admission. What he says in effect is, not that palæontological evidence is against him, but that it is not distinctly in his favour; and, without attempting to attenuate the fact, he accounts for it by the scantiness and the imperfection of that evidence.

[241] What is the state of the case now, when, as we have seen, the amount of our knowledge respecting the mammalia of the Tertiary epoch is increased fifty-fold, and in some directions even approaches completeness?

Simply this, that, if the doctrine of evolution had not existed, palæontologists must have invented it, so irresistibly is it forced upon the mind by the study of the remains of the Tertiary mammalia which have been brought to light since 1859.

Among the fossils of Pikermi, Gaudry found the successive stages by which the ancient civets passed into the more modern hyænas; through the Tertiary deposits of Western America, Marsh tracked the successive forms by which the ancient stock of the horse has passed into its present form; and innumerable less complete indications of the mode of evolution of other groups of the higher mammalia

have been obtained. In the remarkable memoir on the phosphorites of Quercy, to which I have referred, M. Filhol describes no fewer than seventeen varieties of the genus *Cynodictis,* which fill up all the interval between the viverine animals and the bear-like dog *Amphicyon;* nor do I know any solid ground of objection to the supposition that, in this *Cynodictis-Amphicyon* group, we have the stock whence all the Viveridæ, Felidæ, Hyænidæ, Canidæ, and perhaps the Procyonidæ and Ursidæ, [242] of the present fauna have been evolved. On the contrary, there is a great deal to be said in favour.

In the course of summing up his results, M. Filhol observes:–

"During the epoch of the phosphorites, great changes took place in animal forms, and almost the same types as those which now exist became defined from one another.

"Under the influence of natural conditions of which we have no exact knowledge, though traces of them are discoverable, species have been modified in a thousand ways: races have arisen which, becoming fixed, have thus produced a corresponding number of secondary species."

In 1859, language of which this is an unintentional paraphrase, occurring in the "Origin of Species," was scouted as wild speculation; at present, it is a sober statement of the conclusions to which an acute and critically-minded investigator is led by large and patient study of the facts of palæontology. I venture to repeat what I have said before, that so far as the animal world is concerned, evolution is no longer a speculation, but a statement of historical fact. It takes its place alongside of those accepted truths which must be reckoned with by philosophers of all schools.

Thus when, on the first day of October next, "The Origin of Species" comes of age, the promise of its youth will be amply fulfilled; and we [243] shall be prepared to congratulate the venerated author of the book, not only that the greatness of his achievement and its enduring influence upon the progress of knowledge have won him a place beside our Harvey; but, still more, that, like Harvey, he has lived long enough to outlast detraction and opposition, and to see the stone that the builders rejected become the head-stone of the corner.

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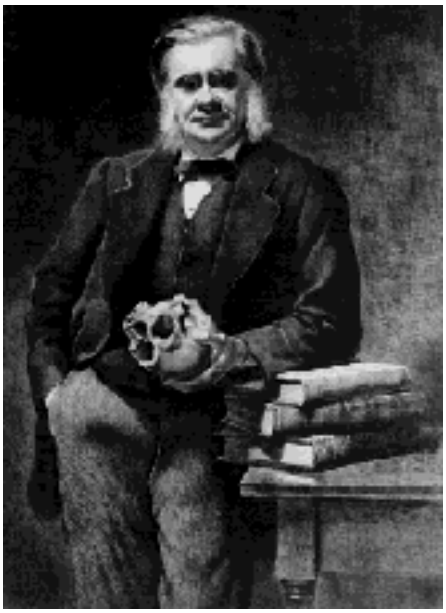
[1] *Origin of Species,* ed. 1, p. 457.

[2] *Origin of Species,* p. 458.

[3] *Origin of Species,* p. 431.

[4] *Origin of Species,* ed.1, p. 463.

THE HUXLEY FILE



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Next article: Charles Darwin [1882], pages 244-247.

Previous article: Evolution in Biology [1878], pages 187-226.

C. Blinderman & D. Joyce
Clark University

Charles Darwin (1882)

Collected Essays II

[244] Very few, even among those who have taken the keenest interest in the progress of the revolution in natural knowledge set afoot by the publication of "The Origin of Species," and who have watched, not without astonishment, the rapid and complete change which has been effected both inside and outside the boundaries of the scientific world in the attitude of men's minds towards the doctrines which are expounded in that great work, can have been prepared for the extraordinary manifestation of affectionate regard for the man, and of profound reverence for the philosopher, which followed the announcement, on Thursday last, of the death of Mr. Darwin.

Not only in these islands, where so many have felt the fascination of personal contact with an [245] intellect which had no superior, and with a character which was even nobler than the intellect; but, in all parts of the civilised world, it would seem that those whose business it is to feel the pulse of nations and to know what interests the masses of mankind, were well aware that thousands of their readers would think the world the poorer for Darwin's death, and would dwell with eager interest upon every incident of his history. In France, in Germany, in Austro-Hungary, in Italy, in the United States, writers of all shades of opinion, for once unanimous, have paid a willing tribute to the worth of our great countryman, ignored in life by the official representatives of the kingdom, but laid in death among his peers in Westminster Abbey by the will of the intelligence of the nation.

It is not for us to allude to the sacred sorrows of the bereaved home at Down; but it is no secret that, outside that domestic group, there are many to whom Mr. Darwin's death is a wholly irreparable loss. And this not merely because of his wonderfully genial, simple, and generous nature; his cheerful and animated conversation, and the infinite variety and accuracy of his information; but because the more one knew of him, the more he seemed the incorporated ideal of a man of science. Acute as were his reasoning powers, vast as was his knowledge, marvellous as was his tenacious industry, under physical difficulties which would [246] have converted nine men out of ten into aimless invalids; it was not these qualities, great as they were, which impressed those who were admitted to his intimacy with involuntary veneration, but a certain intense and almost passionate honesty by which all his thoughts and actions were irradiated, as by a central fire.

It was this rarest and greatest of endowments which kept his vivid imagination and great speculative powers within due bounds; which compelled him to undertake the prodigious labours of original investigation and of reading, upon which his published works are based; which made him accept criticisms and suggestions from anybody and everybody, not only without impatience, but with expressions of gratitude sometimes almost comically in excess of their value; which led him to allow neither himself nor others to be deceived by phrases, and to spare neither time nor pains in order to obtain clear and distinct ideas upon every topic with which he occupied himself.

One could not converse with Darwin without being reminded of Socrates. There was the same desire to find some one wiser than himself; the same belief in the sovereignty of reason; the same ready humour; the same sympathetic interest in all the ways and works of men. But instead of turning away from the problems of Nature as hopelessly insoluble, our modern philosopher devoted his whole life to attacking them in the [247] spirit of Heraclitus and of Democritus, with results which are the substance of which their speculations were anticipatory shadows.

The due appreciation, or even enumeration, of these results is neither practicable nor desirable at this moment. There is a time for all things–a time for glorying in our ever-extending conquests over the realm of Nature, and a time for mourning over the heroes who have led us to victory.

None have fought better, and none have been more fortunate, than Charles Darwin. He found a great truth trodden underfoot, reviled by bigots, and ridiculed by all the world; he lived long enough to see it, chiefly by his own efforts, irrefragably established in science, inseparably incorporated with the common thoughts of men, and only hated and feared by those who would revile, but dare not. What shall a man desire more than this? Once more the image of Socrates rises unbidden, and the noble peroration of the "Apology" rings in our ears as if it were Charles Darwin's farewell:–

"The hour of departure has arrived, and we go our ways–I to die and you to live. Which is the better, God only knows."

THE HUXLEY FILE

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Previous article: The Coming of Age of "The Origin of Species" [1880], pages 227-243.

C. Blinderman & D. Joyce
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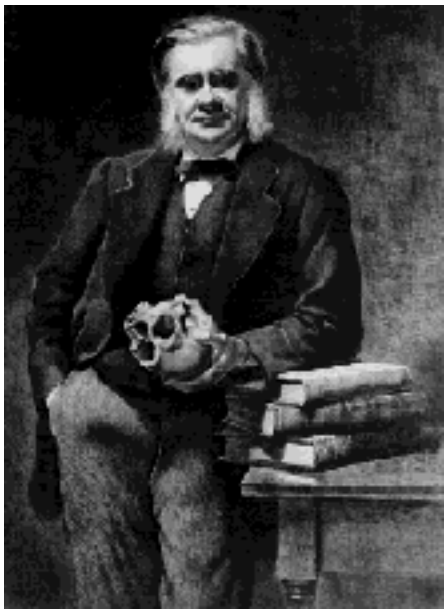

The Darwin Memorial (1885)

Collected Essays II

[248] *Address by the President of the Royal Society, in the name of the Memorial Committee, on handing over the statue of Darwin to H.R.H. the Prince of Wales, as representative of the Trustees of the British Museum.*

Your Royal Highness,–It is now three years since the announcement of the death of our famous countryman, Charles Darwin, gave rise to a manifestation of public feeling, not only in these realms, but throughout the civilised world, which, if I mistake not, is without precedent in the modest annals of scientific biography.

The causes of this deep and wide outburst of emotion are not far to seek. We had lost one of these rare ministers and interpreters of Nature whose names mark epochs in the advance of [249] natural knowledge. For, whatever be the ultimate verdict of posterity upon this or that opinion which Mr. Darwin has propounded; whatever adumbrations or anticipations of his doctrines may be found in the writings of his predecessors; the broad fact remains that, since the publication and by reason of the publication, of "The Origin of Species" the fundamental conceptions and the aims of the students of living Nature have been completely changed. From that work has sprung a great renewal, a true "instauratio magna" of the zoological and botanical sciences.

But the impulse thus given to scientific thought rapidly spread beyond the ordinarily recognised limits of biology. Psychology, Ethics, Cosmology were stirred to their foundations, and the "Origin of Species" proved itself to be the fixed point which the general doctrine of evolution needed in order to move the world. "Darwinism," in one form or another, sometimes strangely distorted and mutilated, became an everyday topic of men's speech, the object of an abundance both of vituperation and of praise, more often than of serious study.

It is curious now to remember how largely, at first, the objectors predominated; but considering the usual fate of new views, it is still more curious to consider for how short a time the phase of vehement opposition lasted. Before twenty years had passed, not only had the importance of [250] Mr. Darwin's work been fully recognised, but the world had discerned the simple, earnest, generous character of the man, that shone through every page of his writings.

I imagine that reflections such as these swept through the minds alike of loving friends and of honourable antagonists when Mr. Darwin died; and that they were at one in the desire to honour the memory of the man who, without fear and without reproach, had successfully fought the hardest intellectual battle of these days.

It was in satisfaction of these just and generous impulses that our great naturalist's remains were

deposited in Westminster Abbey; and that, immediately afterwards, a public meeting, presided over by my lamented predecessor, Mr. Spottiswoode, was held in the rooms of the Royal Society, for the purpose of considering what further step should be taken towards the same end.

It was resolved to invite subscriptions, with the view of erecting a statue of Mr. Darwin in some suitable locality; and to devote any surplus to the advancement of the biological sciences.

Contributions at once flowed in from Austria, Belgium, Brazil, Denmark, France, Germany, Holland, Italy, Norway, Portugal, Russia, Spain, Sweden, Switzerland, the United States, and the British Colonies, no less than from all parts of the three kingdoms; and they came from all classes of the community. To mention one interesting case, [251] Sweden sent in 2296 subscriptions "from all sorts of people," as the distinguished man of science who transmitted them wrote, "from the bishop to the seamstress, and in sums from five pounds to two pence."

The Executive Committee has thus been enabled to carry out the objects proposed. A "Darwin Fund" has been created, which is to be held in trust by the Royal Society, and is to be employed in the promotion of biological research.

The execution of the statue was entrusted to Mr. Boehm; and I think that those who had the good fortune to know Mr. Darwin personally will admire the power of artistic divination which has enabled the sculptor to place before us so very characteristic a likeness of one whom he had not seen.

It appeared to the Committee that, whether they regarded Mr. Darwin's career or the requirements of a work of art, no site could be so appropriate as this great hall, and they applied to the Trustees of the British Museum for permission to erect it in its present position.

That permission was most cordially granted, and I am desired to tender the best thanks of the Committee to the Trustees for their willingness to accede to our wishes.

I also beg leave to offer the expression of our gratitude to your Royal Highness for kindly consenting to represent the Trustees to-day.

[252] It only remains for me, your Royal Highness, my Lords and Gentlemen, Trustees of the British Museum, in the name of the Darwin Memorial Committee, to request you to accept this statue of Charles Darwin.

We do not make this request for the mere sake of perpetuating a memory; for so long as men occupy themselves with the pursuit of truth, the name of Darwin runs no more risk of oblivion than does that of Copernicus, or that of Harvey.

Nor, most assuredly, do we ask you to preserve the statue in its cynosural position in this entrance-hall of our National Museum of Natural History as evidence that Mr. Darwin's views have received your

official sanction; for science does not recognise such sanctions, and commits suicide when it adopts a creed.

No; we beg you to cherish this Memorial as a symbol by which, as generation after generation of students of Nature enter yonder door, they shall be reminded of the ideal according to which they must shape their lives, if they would turn to the best account the opportunities offered by the great institution under your charge.

Darwin Memorial
British Museum (Natural History)
Graphic 9 June 1885

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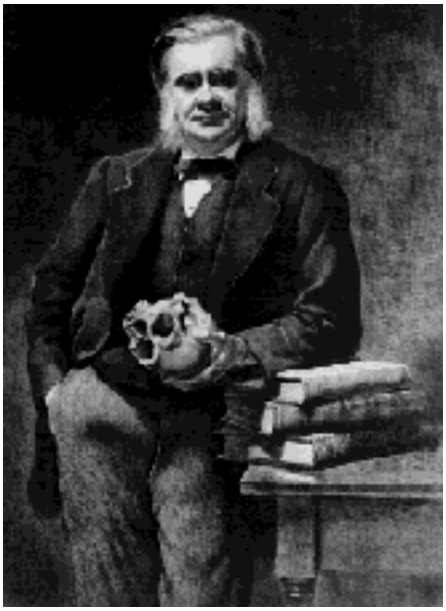

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Previous article: Charles Darwin [1882], pages 244-247.

C. Blinderman & D. Joyce
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Obituary[1] (1888)

Collected Essays II

[253] Charles Robert Darwin was the fifth child and second son of Robert Waring Darwin and Susannah Wedgwood, and was born on the 12th February, 1809, at Shrewsbury, where his father was a physician in large practice.

Mrs. Robert Darwin died when her son Charles was only eight years old, and he hardly remembered her. A daughter of the famous Josiah Wedgwood, who created a new branch of the potter's art, and established the great works of Etruria, could hardly fail to transmit important mental and moral qualities to her children; and there is a solitary record of her direct influence in the story told by a schoolfellow, who remembers Charles Darwin "bringing a flower to school, and [254] saying that his mother had taught him how, by looking at the inside of the blossom, the name of the plant could be discovered." (I., p. 28.[2])

The theory that men of genius derive their qualities from their mothers, however, can hardly derive support from Charles Darwin's case, in the face of the patent influence of his paternal forefathers. Dr. Darwin, indeed, though a man of marked individuality of character, a quick and acute observer, with much practical sagacity, is said not to have had a scientific mind. But when his son adds that his father "formed a theory for almost everything that occurred" (I., p. 20), he indicates a highly probable source for that inability to refrain from forming an hypothesis on every subject which he confesses to be one of the leading characteristics of his own mind, some pages further on (I., p. 103). Dr. R. W. Darwin, again, was the third son of Erasmus Darwin, also a physician of great repute, who shared the intimacy of Watt and Priestley, and was widely known as the author of "Zoonomia," and other voluminous poetical and prose works which had a great vogue in the latter half of the eighteenth century. The celebrity which they enjoyed was in part due to the attractive style (at least according to the taste of that day) in which the author's extensive, though not very profound, [255] acquaintance with natural phenomena was set forth; but in a still greater degree, probably, to the boldness of the speculative views, always ingenious and sometimes fantastic, in which he indulged. The conception of evolution set afoot by De Maillet and others, in the early part of the century, not only found a vigorous champion in Erasmus Darwin, but he propounded an hypothesis as to the manner in which the species of animals and plants have acquired their characters, which is identical in principle with that subsequently rendered famous by Lamarck.

That Charles Darwin's chief intellectual inheritance came to him from the paternal side, then, is hardly doubtful. But there is nothing to show that he was, to any sensible extent, directly influenced by his grandfather's biological work. He tells us that a perusal of the "Zoonomia" in early life produced no effect upon him, although he greatly admired it; and that, on reading it again, ten or fifteen years afterwards, he was much disappointed, "the proportion of speculation being so large to the facts given." But with his usual anxious candour he adds, "Nevertheless, it is probable that the hearing, rather early in life, such views maintained and praised, may have favoured my upholding them, in a different form, in

my 'Origin of Species.'" (I., p. 38.) Erasmus Darwin was in fact an anticipator of Lamarck, and not of Charles Darwin; there is no trace in his works of the [256] conceptions by the addition of which his grandson metamorphosed the theory of evolution as applied to living things and gave it a new foundation.

Charles Darwin's childhood and youth afforded no intimation that he would be, or do, anything out of the common run. In fact, the prognostications of the educational authorities into whose hands he first fell were most distinctly unfavourable; and they counted the only boy of original genius who is known to have come under their hands as no better than a dunce. The history of the educational experiments to which Darwin was subjected is curious, and not without a moral for the present generation. There were four of them, and three were failures. Yet it cannot be said that the materials on which the pedagogic powers operated were other than good. In his boyhood Darwin was strong, well-grown, and active, taking the keen delight in field sports and in every description of hard physical exercise which is natural to an English country-bred lad; and, in respect of things of the mind, he was neither apathetic, nor idle, nor one-sided. The "Autobiography" tells us that he "had much zeal for whatever interested" him, and he was interested in many and very diverse topics. He could work hard, and liked a complex subject better than an easy one. The "clear geometrical proofs" of Euclid delighted him. His interest in practical chemistry, carried out in [257] an extemporised laboratory, in which he was permitted to assist by his elder brother, kept him late at work, and earned him the nickname of "gas" among his schoolfellows. And there could have been no insensibility to literature in one who, as a boy, could sit for hours reading Shakespeare, Milton, Scott, and Byron; who greatly admired some of the Odes of Horace; and who, in later years, on board the "Beagle," when only one book could be carried on an expedition, chose a volume of Milton for his companion.

Industry, intellectual interests, the capacity for taking pleasure in deductive reasoning, in observation, in experiment, no less than in the highest works of imagination; where these qualities are present any rational system of education should surely be able to make something of them. Unfortunately for Darwin, the Shrewsbury Grammar School, though good of its kind, was an institution of a type universally prevalent in this country half a century ago, and by no means extinct at the present day. The education given was "strictly classical," "especial attention" being "paid to verse-making," while all other subjects, except a little ancient geography and history, were ignored. Whether, as in some famous English schools at that date and much later, elementary arithmetic was also left out of sight does not appear; but the instruction in Euclid which gave Charles Darwin so much satisfaction was certainly supplied by a [258] private tutor. That a boy, even in his leisure hours, should permit himself to be interested in any but book-learning seems to have been regarded as little better than an outrage by the head master, who thought it his duty to administer a public rebuke to young Darwin for wasting his time on such a contemptible subject as chemistry. English composition and literature, modern languages, modern history, modern geography, appear to have been considered to be as despicable as chemistry.

For seven long years Darwin got through his appointed tasks; construed without cribs, learned by rote whatever was demanded, and concocted his verses in approved schoolboy fashion. And the result, as it appeared to his mature judgment, was simply negative. "The school as a means of education to me was simply a blank." (I. p. 32.) On the other hand, the extraneous chemical exercises, which the head master

treated so contumeliously, are gratefully spoken of as the "best part" of his education while at school. Such is the judgment of the scholar on the school; as might be expected, it has its counterpart in the judgment of the school on the scholar. The collective intelligence of the staff of Shrewsbury School could find nothing but dull mediocrity in Charles Darwin. The mind that found satisfaction in knowledge, but very little in mere learning; that could appreciate literature, but had no par[259]ticular aptitude for grammatical exercises; appeared to the "strictly classical" pedagogue to be no mind at all. As a matter of fact, Darwin's school education left him ignorant of almost all the things which it would have been well for him to know, and untrained in all the things it would have been useful for him to be able to do, in after life. Drawing, practice in English composition, and instruction in the elements of the physical sciences, would not only have been infinitely valuable to him in reference to his future career, but would have furnished the discipline suited to his faculties, whatever that career might be. And a knowledge of French and German especially the latter, would have removed from his path obstacles which he never fully overcame.

Thus, starved and stunted on the intellectual side, it is not surprising that Charles Darwin's energies were directed towards athletic amusements and sport, to such an extent, that even his kind and sagacious father could be exasperated into telling him that "he cared for nothing but shooting, dogs, and rat-catching." (I. p. 32.) It would be unfair to expect even the wisest of fathers to have foreseen that the shooting and the rat-catching, as training in the ways of quick observation and in physical endurance, would prove more valuable than the construing and verse-making to his son, whose attempt, at a later period of his life, to persuade himself "that shooting was almost an [260] intellectual employment: it required so much skill to judge where to find most game, and to hunt the dogs well" (I. p. 43), was by no means so sophistical as he seems to have been ready to admit.

In 1825, Dr. Darwin came to the very just conclusion that his son Charles would do no good by remaining at Shrewsbury School, and sent him to join his elder brother Erasmus, who was studying medicine at Edinburgh, with the intention that the younger son should also become a medical practitioner. Both sons, however, were well aware that their inheritance would relieve them from the urgency of the struggle for existence which most professional men have to face; and they seemed to have allowed their tastes, rather than the medical curriculum, to have guided their studies. Erasmus Darwin was debarred by constant ill-health from seeking the public distinction which his high intelligence and extensive knowledge would, under ordinary circumstances, have insured. He took no great interest in biological subjects, but his companionship must have had its influence on his brother. Still more was exerted by friends like Coldstream and Grant, both subsequently well-known zoologists (and the latter an enthusiastic Lamarckian), by whom Darwin was induced to interest himself in marine zoology. A notice of the ciliated germs of *Flustra*, communicated to the Plinian Society in 1826, was the first fruits of Darwin's half century of scientific work. Occa[261]sional attendance at the Wernerian Society brought him into relation with that excellent ornithologist the elder Macgillivray, and enabled him to see and hear Audubon. Moreover, he got lessons in bird-stuffing from a negro, who had accompanied the eccentric traveller Waterton in his wanderings, before settling in Edinburgh.

No doubt Darwin picked up a great deal of valuable knowledge during his two years' residence in Scotland; but it is equally clear that next to none of it came through the regular channels of academic

education. Indeed, the influence of the Edinburgh professoriate appears to have been mainly negative, and in some cases deterrent; creating in his mind, not only a very low estimate of the value of lectures, but an antipathy to the subjects which had been the occasion of the boredom inflicted upon him by their instrumentality. With the exception of Hope, the Professor of Chemistry, Darwin found them an "intolerably dull." Forty years afterwards he writes of the lectures of the Professor of Materia Medica that they were "fearful to remember." The Professor of Anatomy made his lectures "as dull as he was himself," and he must have been very dull to have wrung from his victim the sharpest personal remark recorded as his. But the climax seems to have been attained by the Professor of Geology and Zoology, whose prælections were so "incredibly dull" that they produced in their hearer the some[262]what rash determination never "to read a book on geology or in any way to study the science" so long as he lived. (I. p. 41.)

There is much reason to believe that the lectures in question were eminently qualified to produce the impression which they made; and there can be little doubt, that Darwin's conclusion that his time was better employed in reading than in listening to such lectures was a sound one. But it was particularly unfortunate that the personal and professorial dulness of the Professor of Anatomy, combined with Darwin's sensitiveness to the disagreeable concomitants of anatomical work, drove him away from the dissecting room. In after life, he justly recognised that this was an "irremediable evil" in reference to the pursuits he eventually adopted; indeed, it is marvellous that he succeeded in making up for his lack of anatomical discipline, so far as his work on the Cirripedes shows he did. And the neglect of anatomy had the further unfortunate result that it excluded him from the best opportunity of bringing himself into direct contact with the facts of nature which the University had to offer. In those days, almost the only practical scientific work accessible to students was anatomical, and the only laboratory at their disposal the dissecting room.

We may now console ourselves with the reflection that the partial evil was the general [263] good. Darwin had already shown an aptitude for practical medicine (I. p. 37); and his subsequent career proved that he had the making of an excellent anatomist. Thus, though his horror of operations would probably have shut him off from surgery, there was nothing to prevent him (any more than the same peculiarity prevented his father) from passing successfully through the medical curriculum and becoming, like his father and grandfather, a successful physician, in which case "The Origin of Species" would not have been written. Darwin has jestingly alluded to the fact that the shape of his nose (to which Captain Fitzroy objected), nearly prevented his embarkation in the "Beagle"; it may be that the sensitiveness of that organ secured him for science.

At the end of two years' residence in Edinburgh it hardly needed Dr. Darwin's sagacity to conclude that a young man, who found nothing but dulness in professorial lucubrations, could not bring himself to endure a dissecting room, fled from operations, and did not need a profession as a means of livelihood, was hardly likely to distinguish himself as a student of medicine. He therefore made a new suggestion, proposing that his son should enter an English University and qualify for the ministry of the Church. Charles Darwin found the proposal agreeable, none the less, probably, that a good deal of natural history [264] and a little shooting were by no means held, at that time, to be incompatible with the conscientious performance of the duties of a country clergyman. But it is characteristic of the man, that he asked time

for consideration, in order that he might satisfy himself that he could sign the Thirty-nine Articles with a clear conscience. However, the study of "Pearson on the Creeds" and a few other books of divinity soon assured him that his religious opinions left nothing to be desired on the score of orthodoxy, and he acceded to his father's proposition.

The English University selected was Cambridge; but an unexpected obstacle arose from the fact that, within the two years which had elapsed, since the young man who had enjoyed seven years of the benefit of a strictly classical education had left school, he had forgotten almost everything he had learned there, "even to some few of the Greek letters." (I. p. 46.) Three months with a tutor, however, brought him back to the point of translating Homer and the Greek Testament "with moderate facility," and Charles Darwin commenced the third educational experiment of which he was the subject, and was entered on the books of Christ's College in October 1827. So far as the direct results of the academic training thus received are concerned, the English University was not more successful than the Scottish. "During the three years which I spent [265] at Cambridge my time was wasted, as far as the academical studies were concerned, as completely as at Edinburgh and as at school." (I. p. 46.) And yet, as before, there is ample evidence that this negative result cannot be put down to any native defect on the part of the scholar. Idle and dull young men, or even young men who being neither idle nor dull, are incapable of caring for anything but some hobby, do not devote themselves to the thorough study of Paley's "Moral Philosophy," and "Evidences of Christianity "; nor are their reminiscences of this particular portion of their studies expressed in terms such as the following: "The logic of this book [the 'Evidences '] and, as I may add, of his 'Natural Theology' gave me as much delight as did Euclid." (I. p. 47.)

The collector's instinct, strong in Darwin from his childhood, as is usually the case in great naturalists, turned itself in the direction of Insects during his residence at Cambridge. In childhood it had been damped by the moral scruples of a sister, as to the propriety of catching and killing insects for the mere sake of possessing them, but now it broke out afresh, and Darwin became an enthusiastic beetle collector. Oddly enough he took no scientific interest in beetles, not even troubling himself to make out their names; his delight lay in the capture of a species which turned out to be rare or new, and still more in [266] finding his name, as captor, recorded in print. Evidently, this beetle-hunting hobby had little to do with science, but was mainly a new phase of the old and undiminished love of sport. In the intervals of beetle-catching, when shooting and hunting were not to be had, riding across country answered the purpose. These tastes naturally threw the young undergraduate among a set of men who preferred hard riding to hard reading, and wasted the midnight oil upon other pursuits than that of academic distinction. A superficial observer might have had some grounds to fear that Dr. Darwin's wrathful prognosis might yet be verified. But if the eminently social tendencies of a vigorous and genial nature sought an outlet among a set of jovial sporting friends, there were other and no less strong proclivities which brought him into relation with associates of a very different stamp.

Though almost without ear and with a very defective memory for music, Darwin was so strongly and pleasurably affected by it that he became a member of a musical society; and an equal lack of natural capacity for drawing did not prevent him from studying good works of art with much care.

An acquaintance with even the rudiments of physical science was no part of the requirements for the

ordinary Cambridge degree. But there were professors both of Geology and of Botany [267] whose lectures were accessible to those who chose to attend them. The occupants of these chairs, in Darwin's time, were eminent men and also admirable lecturers in their widely different styles. The horror of geological lectures which Darwin had acquired at Edinburgh, unfortunately prevented him from going within reach of the fervid eloquence of Sedgwick; but he attended the botanical course, and though he paid no serious attention to the subject, he took great delight in the country excursions, which Henslow so well knew how to make both pleasant and instructive. The Botanical Professor was, in fact, a man of rare character and singularly extensive acquirements in all branches of natural history. It was his greatest pleasure to place his stores of knowledge at the disposal of the young men who gathered about him, and who found in him, not merely an encyclopedic teacher but a wise counsellor, and, in case of worthiness, a warm friend. Darwin's acquaintance with him soon ripened into a friendship which was terminated only by Henslow's death in 1861, when his quondam pupil gave touching expression to his sense of what he owed to one whom he calls (in one of his letters) his "dear old master in Natural History." (II. p. 217.) It was by Henslow's advice that Darwin was led to break the vow he had registered against making an acquaintance with geology; and it was through Henslow's good offices with Sedgwick that he [268] obtained the opportunity of accompanying the Geological Professor on one of his excursions in Wales. He then received a certain amount of practical instruction in Geology, the value of which he subsequently warmly acknowledged. (I. p. 237.) In another direction, Henslow did him an immense, though not altogether intentional service, by recommending him to buy and study the recently published first volume of Lyell's "Principles." As an orthodox geologist of the then dominant catastrophic school, Henslow accompanied his recommendation with the admonition on no account to adopt Lyell's general views. But the warning fell on deaf ears, and it is hardly too much to say that Darwin's greatest work is the outcome of the unflinching application to Biology of the leading idea and the method applied in the "Principles" to geology.[3] Finally, it was through Henslow, and at his suggestion, that Darwin was offered the appointment to the "Beagle" as naturalist.

During the latter part of Darwin's residence at Cambridge the prospect of entering the Church, though the plan was never formally renounced, [269] seems to have grown very shadowy. Humboldt's "Personal Narrative," and Herschel's "Introduction to the Study of Natural Philosophy," fell in his way and revealed to him his real vocation. The impression made by the former work was very strong. "My whole course of life," says Darwin in sending a message to Humboldt, "is due to having read and re-read, as a youth, his personal narrative." (I. p. 336.) The description of Teneriffe inspired Darwin with such a strong desire to visit the island, that he took some steps towards going there–inquiring about ships, and so on.

But, while this project was fermenting, Henslow, who had been asked to recommend a naturalist for Captain Fitzroy's projected expedition, at once thought of his pupil. In his letter of the 24th August, 1831, he says: "I have stated that I consider you to be the best qualified person I know of who is likely to undertake such a situation. I state this–not on the supposition of your being a *finished* naturalist, but as amply qualified for collecting, observing, and noting anything worthy to be noted in Natural History .... The voyage is to last two years, and if you take plenty of books with you, anything you please may be done." (I. p. 193.) The state of the case could not have been better put. Assuredly the young naturalist's

theoretical and practical scientific training had gone no further than might suffice for the outfit [270] of an intelligent collector and note-taker. He was fully conscious of the fact, and his ambition hardly rose above the hope that he should bring back materials for the scientific "lions" at home of sufficient excellence to prevent them from turning and rending him. (I. p. 248.)

But a fourth educational experiment was to be tried. This time Nature took him in hand herself and showed him the way by which, to borrow Henslow's prophetic phrase, "anything he pleased might be done."

The conditions of life presented by a ship-of-war of only 242 tons burthen, would not, *prima facie*, appear to be so favourable to intellectual development as those offered by the cloistered retirement of Christ's College. Darwin had not even a cabin to himself; while, in addition to the hindrances and interruptions incidental to sea-life, which can be appreciated only by those who have had experience of them, sea-sickness came on whenever the little ship was "lively"; and, considering the circumstances of the cruise, that must have been her normal state. Nevertheless, Darwin found on board the "Beagle" that which neither the pedagogues of Shrewsbury, nor the professoriate of Edinburgh, nor the tutors of Cambridge had managed to give him. "I have always felt that I owe to the voyage the first real training or education of my mind (I. p. 61);" and in a letter written as he was leaving England, he calls the [271] voyage on which he was starting, with just insight, his "second life." (I. p. 214.) Happily for Darwin's education, the school time of the "Beagle" lasted five years instead of two; and the countries which the ship visited were singularly well fitted to provide him with object-lessons, on the nature of things, of the greatest value.

While at sea, he diligently collected, studied, and made copious notes upon the surface Fauna. But with no previous training in dissection, hardly any power of drawing, and next to no knowledge of comparative anatomy, his occupation with work of this kind–notwithstanding all his zeal and industry–resulted, for the most part, in a vast accumulation of useless manuscript. Some acquaintance with the marine *Crustacea,* observations on *Planariæ* and on the ubiquitous *Sagitta,* seem to have been the chief results of a great amount of labour in this direction.

It was otherwise with the terrestrial phenomena which came under the voyager's notice: and Geology very soon took her revenge for the scorn which the much-bored Edinburgh student had poured upon her. Three weeks after leaving England the ship touched land for the first time at St. Jago, in the Cape de Verd Islands, and Darwin found his attention vividly engaged by the volcanic phenomena and the signs of upheaval which the island presented. His geological studies had already indicated the direction in [272] which a great deal might be done, beyond collecting; and it was while sitting beneath a low lava cliff on the shore of this island, that a sense of his real capability first dawned upon Darwin, and prompted the ambition to write a book on the geology of the various countries visited. (I. p. 66.) Even at this early date, Darwin must have thought much on geological topics, for he was already convinced of the superiority of Lyell's views to those entertained by the catastrophists[4]; and his subsequent study of the tertiary deposits and of the terraced gravel beds of South America was eminently fitted to strengthen that conviction. The letters from South America contain little reference to any scientific topic except

geology; and even the theory of the formation of coral reefs was prompted by the evidence of extensive and gradual changes of level afforded by the geology of South America; "No other work of mine," he says, "was begun in so deductive a spirit as this; for the whole theory was thought out on the West Coast of South America, before I had seen a true coral reef I had, therefore, only to verify and extend my views by a careful exam[273]ination of living reefs.' (I. p. 70.) In 1835, when starting from Lima for the Galapagos, he recommends his friend, W. D. Fox, to take up geology:–"There is so much larger a field for thought than in the other branches of Natural History. I am become a zealous disciple of Mr. Lyell's views, as made known in his admirable book. Geologising in South America, I am tempted to carry parts to a greater extent even than he does. Geology is a capital science to begin with, as it requires nothing but a little reading, thinking, and hammering." (I. p. 263.) The truth of the last statement, when it was written, is a curious mark of the subsequent progress of geology. Even so late as 1836, Darwin speaks of being "much more inclined for geology than the other branches of Natural History." (I. p. 275.)

At the end of the letter to Mr. Fox, however, a little doubt is expressed whether zoological studies might not, after all, have been more profitable; and an interesting passage in the "Autobiography" enables us to understand the origin of this hesitation.

"During the voyage of the 'Beagle' I had been deeply impressed by discovering in the Pampean formation great fossiI animals covered with armour like that on the existing armadillos; secondly, by the manner in which closely-allied animals replace one another in proceeding southwards over the continent; and, thirdly, by the South American [274] character of most of the productions of the Galapagos Archipelago, and, more especially, by the manner in which they differ slightly on each island of the group; some of the islands appearing to be very ancient in a geological sense.

"It was evident that such facts as these, as well as many others, could only be explained on the supposition that species gradually become modified; and the subject haunted me. But it was equally evident that neither the action of the surrounding conditions, nor the will of the organisms (especially in the case of plants) could account for the innumerable cases in which organisms of every kind are beautifully adapted to their habits of life; for instance, a woodpecker or a tree-frog to climb trees, or a seed for dispersal by hooks or plumes. I had always been much struck by such adaptations, and until these could be explained it seemed to me almost useless to endeavour to prove by indirect evidence that species have been modified." (I. p. 82.)

The facts to which reference is here made were, without doubt, eminently fitted to attract the attention of a philosophical thinker; but, until the relations of the existing with the extinct species and of the species of the different geographical areas with one another, were determined with some exactness, they afforded but an unsafe foundation for speculation. It was not possible that this determination should have been effected before [275] the return of the "Beagle" to England; and thus the date which Darwin (writing in 1837) assigns to the dawn of the new light which was rising in his mind becomes intelligible.[5]

"In July opened first note-book on Transmutation of Species. Had been greatly struck from about the month of previous March on character of South American fossils and species on Galapagos Archipelago.

These facts (especially latter) origin of all my views." (I. p. 276.)

From March, 1837, then, Darwin, not without many misgivings and fluctuations of opinion, inclined towards transmutation as a provisional hypothesis. Three months afterwards he is hard at work collecting facts for the purpose of testing the hypothesis; and an almost apologetic passage in a letter to Lyell shows that, already, the attractions of biology are beginning to predominate over those of geology.

"I have lately been sadly tempted to be idle[6]–[276] that is, as far as pure Geology is concerned–by the delightful number of new views which have been coming in thickly and steadily–on the classification and affinities and instincts of animals–bearing on the question of species. Note-book after note-book has been filled with facts which begin to group themselves *clearly* under sub-laws." (I. p. 298.)

The problem which was to be Darwin's chief subject of occupation for the rest of his life thus presented itself, at first, mainly under its distributional aspect. Why do species present certain relations in space and in time? Why are the animals and plants of the Galapagos Archipelago so like those of South America and yet different from them? Why are those of the several islets more or less different from one another? Why are the animals of the latest geological epoch in South America similar in *facies* to those which exist in the same region at the present day, and yet specifically or generically different?

The reply to these questions, which was almost universally received fifty years ago, was that animals and plants were created such as they are; and that their present distribution, at any rate so far as terrestrial organisms are concerned, has been effected by the migration of their ancestors from [277] the region in which the ark stranded after the subsidence of the deluge. It is true that the geologists had drawn attention to a good many tolerably serious difficulties in the way of the diluvial part of this hypothesis, no less than to the supposition that the work of creation had occupied only a brief space of time. But even those, such as Lyell, who most strenuously argued in favour of the sufficiency of natural causes for the production of the phenomena of the inorganic world, held stoutly by the hypothesis of creation in the case of those of the world of life.

For persons who were unable to feel satisfied with the fashionable doctrine, there remained only two alternatives–the hypothesis of spontaneous generation, and that of descent with modification. The former was simply the creative hypothesis with the creator left out; the latter had already been propounded by De Maillet and Erasmus Darwin, among others; and, later, systematically expounded by Lamarck. But in the eyes of the naturalist of the "Beagle" (and, probably, in those of most sober thinkers), the advocates of transmutation had done the doctrine they expounded more harm than good.

Darwin's opinion of the scientific value of the "Zoonomia" has already been mentioned. His verdict on Lamarck is given in the following passage of a letter to Lyell (March, 1863):–

"Lastly, you refer repeatedly to my view as a [278] modification of Lamarck's doctrine of development and progression. If this is your deliberate opinion there is nothing to be said, but it does not seem so to me. Plato, Buffon, my grandfather, before Lamarck and others, propounded the *obvious* view that if

species were not created separately they must have descended from other species, and I can see nothing else in common between the "Origin" and Lamarck. I believe this way of putting the case is very injurious to its acceptance, as it implies necessary progression, and closely connects Wallace's and my views with what I consider, after two deliberate readings, as a wretched book, and one from which (I well remember to my surprise) I gained nothing."

"But," adds Darwin with a little touch of banter, "I know you rank it higher, which is curious, as it did not in the least shake your belief" (III. p. 14; see also p. 16, "to me it was an absolutely useless book.")

Unable to find any satisfactory theory of the process of descent with modification in the works of his predecessors, Darwin proceeded to lay the foundations of his own views independently; and he naturally turned, in the first place, to the only certainly known examples of descent with modification, namely, those which are presented by domestic animals and cultivated plants. He devoted himself to the study of these cases with a thoroughness to which none of his predecessors [279] even remotely approximated; and he very soon had his reward in the discovery "that selection was the keystone of man's success in making useful races of animals and plants." (I. p. 83.)

This was the first step in Darwin's progress, though its immediate result was to bring him face to face with a great difficulty. "But how selection could be applied to organisms living in a state of nature remained for some time a mystery to me." (I. p. 83.)

The key to this mystery was furnished by the accidental perusal of the famous essay of Malthus "On Population" in the autumn of 1838. The necessary result of unrestricted multiplication is competition for the means of existence. The success of one competitor involves the failure of the rest, that is, their extinction; and this "selection" is dependent on the better adaptation of the successful competitor to the conditions of the competition. Variation occurs under natural, no less than under artificial, conditions. Unrestricted multiplication implies the competition of varieties and the selection of those which are relatively best adapted to the conditions.

Neither Erasmus Darwin, nor Lamarck, had any inkling of the possibility of this process of "natural selection"; and though it had been foreshadowed by Wells in 1813, and more fully stated by Matthew in 1831, the speculations of the latter [280] writer remained unknown to naturalists until after the publication of the "Origin of Species."

Darwin found in the doctrine of the selection of favourable variations by natural causes, which thus presented itself to his mind, not merely a probable theory of the origin of the diverse species of living forms, but that explanation of the phenomena of adaptation, which previous speculations had utterly failed to give. The process of natural selection is, in fact, dependent on adaptation–it is all one, whether one says that the competitor which survives is the "fittest" or the "best adapted." And it was a perfectly fair deduction that even the most complicated adaptations might result from the summation of a long series of simple favourable variations.

Darwin notes as a serious defect in the first sketch of his theory that he had omitted to consider one very important problem, the solution of which did not occur to him till some time afterwards. "This problem is the tendency in organic beings descended from the same stock to diverge in character as they become modified.... The solution, as I believe, is that the modified offspring of all dominant and increasing forms tend to become adapted to many and highly diversified places in the economy of nature." (1. p. 84.)

It is curious that so much importance should be attached to this supplementary idea. It seems obvious that the theory of the origin of species [281] by natural selection necessarily involves the divergence of the forms selected. An individual which varies, *ipso facto* diverges from the type of its species; and its progeny, in which the variation becomes intensified by selection, must diverge still more, not only from the parent stock, but from any other race of that stock starting from a variation of a different character. The selective process could not take place unless the selected variety was either better adapted to the conditions than the original stock, or adapted to other conditions than the original stock. In the first case, the original stock would be sooner or later extirpated; in the second, the type, as represented by the original stock and the variety, would occupy more diversified stations than it did before.

The theory, essentially such as it was published fourteen years later, was written out in 1844, and Darwin was so fully convinced of the importance of his work, as it then stood, that he made special arrangements for its publication in case of his death. But it is a singular example of reticent fortitude, that, although for the next fourteen years the subject never left his mind, and during the latter half of that period he was constantly engaged in amassing facts bearing upon it from wide reading, a colossal correspondence, and a long series of experiments, only two or three friends were cognisant of his views. To the outside world he seemed to have his hands quite sufficiently full of [282] other matters. In 1844, he published his observations on the volcanic islands visited during the voyage of the "Beagle." In 1845, a largely remodelled edition of his "Journal" made its appearance, and immediately won, as it has ever since held, the favour of both the scientific and the unscientific public. In 1846, the "Geological Observations in South America" came out, and this book was no sooner finished than Darwin set to work upon the Cirripedes. He was led to undertake this long and heavy task, partly by his desire to make out the relations of a very anomalous form which he had discovered on the coast of Chili; and partly by a sense of "presumption in accumulating facts and speculating on the subject of variation without having worked out my due share of species." (II. p. 31.) The eight or nine years of labour, which resulted in a monograph of first-rate importance in systematic zoology (to say nothing of such novel points as the discovery of complemental males), left Darwin no room to reproach himself on this score, and few will share his "doubt whether the work was worth the consumption of so much time." (I. p. 82.)

In science no man can safely speculate about the nature and relation of things with which he is unacquainted at first hand, and the acquirement of an intimate and practical knowledge of the process of species-making and of all the uncertainties which underlie the boundaries between species [283] and varieties, drawn by even the most careful and conscientious systematists[7] were of no less importance to the author of the "Origin of Species" than was the bearing of the Cirripede work upon "the principles of a natural classification." (I. p. 81.) No one, as Darwin justly observes, has a "right to examine the

question of species who has not minutely described many." (II. p. 39.)

In September, 1854, the Cirripede work was finished, "ten thousand barnacles" had been sent "out of the house, all over the world," and Darwin had the satisfaction of being free to turn again to his "old notes on species." In 1855, he began to breed pigeons, and to make observations on the effects of use and disuse, experiments on seeds, and so on, while resuming his industrious collection of facts, with a view "to see how far they favour or are opposed to the notion that wild species are mutable or immutable. I mean with my utmost power to give all arguments and facts on both sides. I have a *number* of people helping me every way, and giving me most valuable [284] assistance; but I often doubt whether the subject will not quite overpower me." (II. p. 49.)

Early in 1856, on Lyell's advice, Darwin began to write out his views on the origin of species on a scale three or four times as extensive as that of the work published in 1859. In July of the same year he gave a brief sketch of his theory in a letter to Asa Gray; and, in the year 1857, his letters to his correspondents show him to be busily engaged on what he calls his "big book." (II. pp. 83, 94.) In May, 1857, Darwin writes to Wallace: "I am now preparing my work [on the question how and in what way do species and varieties differ from each other] for publication, but I find the subject so very large, that, though I have written many chapters, I do not suppose I shall go to press for two years." (II. p. 95.) In December, 1857, he writes, in the course of a long letter to the same correspondent, "I am extremely glad to hear that you are attending to distribution in accordance with theoretical ideas. I am a firm believer that without speculation there is no good and original observation." (II. p. 108.)[8] In June, 1858, he received from Mr. Wallace, then in the Malay Archipelago, an "Essay on the tendency of varieties to depart indefinitely from [285] the original type," of which Darwin says, "If Wallace had my MS. sketch written out in 1842 he could not have made a better short abstract! Even his terms stand now as heads of my chapters. Please return me the MS., which he does not say he wishes me to publish, but I shall, of course, at once write and offer to send it to any journal. So all my originality, whatever it may amount to, will be smashed, though my book, if ever it will have any value, will not be deteriorated; as all the labour consists in the application of the theory." (II. p. 116.)

Thus, Darwin's first impulse was to publish Wallace's essay without note or comment of his own. But, on consultation with Lyell and Hooker, the latter of whom had read the sketch of 1844, they suggested, as an undoubtedly more equitable course, that extracts from the MS. of 1844 and from the letter to Dr. Asa Gray should be communicated to the Linnean Society along with Wallace's essay. The joint communication was read on July 1, 1858, and published under the title "On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection." This was followed, on Darwin's part, by the composition of a summary account of the conclusions to which his twenty years' work on the species question had led him. It occupied him for thirteen months, and appeared in November, [286] 1859, under the title "On the Origin of Species by means of Natural Selection or the Preservation of Favoured Races in the Struggle of Life."

It is doubtful if any single book, except the "Principia," ever worked so great and so rapid a revolution in science, or made so deep an impression on the general mind. It aroused a tempest of opposition and met

with equally vehement support, and it must be added that no book has been more widely and persistently misunderstood by both friends and foes. In 1861, Darwin remarks to a correspondent, "You understand my book perfectly, and that I find a very rare event with my critics." (I. p. 313.) The immense popularity which the "Origin" at once acquired was no doubt largely due to its many points of contact with philosophical and theological questions in which every intelligent man feels a profound interest; but a good deal must be assigned to a somewhat delusive simplicity of style, which tends to disguise the complexity and difficulty of the subject, and much to the wealth of information on all sorts of curious problems of natural history, which is made accessible to the most unlearned reader. But long occupation with the work has led the present writer to believe that the "Origin of Species" is one of the hardest of books to master;[9] and he is justified in this [287] conviction by observing that although the "Origin" has been close on thirty-years before the world, the strangest misconceptions of the essential nature of the theory therein advocated are still put forth by serious writers.

Although, then, the present occasion is not suitable for any detailed criticism of the theory, or of the objections which have been brought against it, it may not be out of place to endeavour to separate the substance of the theory from its accidents; and to show that a variety not only of hostile comments, but of friendly would-be improvements lose their *raison d'être* to the careful student. Observation proves the existence among all living beings of phenomena of three kinds, denoted by the terms heredity, variation, and multiplication. Progeny tend to resemble their parents; nevertheless all their organs and functions are susceptible of departing more or less from the average parental character; and their number is in excess of that of their parents. Severe competition for the means of living, or the struggle for existence, is a necessary consequence of unlimited multiplication; while selection, or the preservation of favourable variations and the extinction of others, is a necessary consequence of severe competition. "Favourable variations" are those which are better adapted to surrounding conditions. It [288] follows, therefore, that every variety which is selected into a species is so favoured and preserved in consequence of being, in some one or more respects, better adapted to its surroundings than its rivals. In other words, every species which exists, exists in virtue of adaptation, and whatever accounts for that adaptation accounts for the existence of the species.

To say that Darwin has put forward a theory of the adaptation of species, but not of their origin, is therefore to misunderstand the first principles of the theory. For, as has been pointed out, it is a necessary consequence of the theory of selection that every species must have some one or more structural or functional peculiarities, in virtue of the advantage conferred by which, it has fought through the crowd of its competitors and achieved a certain duration. In this sense, it is true that every species has been "originated" by selection.

There is another sense, however, in which it is equally true that selection originates nothing. "Unless profitable variations .... occur natural selection can do nothing" ("Origin," Ed. I. p. 82). "Nothing can be effected unless favourable variations occur" (*ibid.*, p. 108). "What applies to one animal will apply throughout time to all animals–that is, if they vary–for otherwise natural selection can do nothing. So it will be with plants" (*ibid.*, p. 113). Strictly speaking, [289] therefore, the origin of species in general lies in variation; while the origin of any particular species lies, firstly, in the occurrence, and secondly, in the

selection and preservation of a particular variation. Clearness on this head will relieve one from the necessity of attending to the fallacious assertion that natural selection is a *deus ex machinâ* or occult agency.

Those, again, who confuse the operation of the natural causes which bring about variation and selection with what they are pleased to call "chance" can hardly have read the opening paragraph of the fifth chapter of the "Origin" (Ed. I, p. 131): "I have sometimes spoken as if the variations .... had been due to chance. This is of course a wholly incorrect expression, but it seems to acknowledge plainly our ignorance of the cause of each particular variation."

Another point of great importance to the right comprehension of the theory, is, that while every species must needs have some adaptive advantageous characters to which it owes its preservation by selection, it may possess any number of others which are neither advantageous nor disadvantageous, but indifferent, or even slightly disadvantageous. (*Ibid.*, p. 81.) For variations take place, not merely in one organ or function at a time, but in many; and thus an advantageous variation, which gives rise to the selection of a new race or species, may be accompanied by others which are [290] indifferent, but which are just as strongly hereditary as the advantageous variations. The advantageous structure is but one product of a modified general constitution which may manifest itself by several other products; and the selective process carries the general constitution along with the advantageous special peculiarity. A given species of plant may owe its existence to the selective adaptation of its flowers to insect fertilisers; but the character of its leaves may be the result of variations of an indifferent character. It is the origin of variations of this kind to which Darwin refers in his frequent reference to what he calls "laws of correlation of growth" or "correlated variation."

These considerations lead us further to see the inappropriateness of the objections raised to Darwin's theory on the ground that natural selection does not account for the first commencements of useful organs. But it does not pretend to do so. The source of such commencements is necessarily to be sought in different variations, which remain unaffected by selection until they have taken such a form as to become utilisable in the struggle for existence.

It is not essential to Darwin's theory that anything more should be assumed than the facts of heredity, variation, and unlimited multiplication; and the validity of the deductive reasoning as to the effect of the last (that is, of the struggle for existence which it involves) upon the varieties [291] resulting from the operation of the former. Nor is it essential that one should take up any particular position in regard to the mode of variation, whether, for example, it takes place *per saltum* or gradually; whether it is definite in character or indefinite. Still less are those who accept the theory bound to any particular views as to the causes of heredity or of variation.

That Darwin held strong opinions on some or all of these points may be quite true; but, so far as the theory is concerned, they must be regarded as *obiter dicta.* With respect to the causes of variation, Darwin's opinions are, from first to last, put forward altogether tentatively. In the first edition of the "Origin," he attributes the strongest influence to changes in the conditions of life of parental organisms,

which he appears to think act on the germ through the intermediation of the sexual organs. He points out, over and over again, that habit, use, disuse, and the direct influence of conditions have some effect, but he does not think it great, and he draws attention to the difficulty of distinguishing between effects of these agencies and those of selection. There is, however, one class of variations which he withdraws from the direct influence of selection, namely, the variations in the fertility of the sexual union of more or less closely allied forms. He regards less fertility, or more or less complete sterility, as "incidental to other acquired differences." (*Ibid.*, p. 245.)

[292] Considering the difficulties which surround the question of the causes of variation, it is not to be wondered at, that Darwin should have inclined, sometimes, rather more to one and, sometimes, rather more to another of the possible alternatives. There is little difference between the last edition of the "Origin" (1872) and the first on this head. In 1876, however, he writes to Moritz Wagner, "In my opinion, the greatest error which I have committed has been not allowing sufficient weight to the direct action of the environments, i.e., food, climate, &c., independently of natural selection.....When I wrote the 'Origin,' and for some years afterwards, I could find little good evidence of the direct action of the environment; now there is a large body of evidence, and your case of the Saturnia is one of the most remarkable of which I have heard." (III, p. 159.) But there is really nothing to prevent the most tenacious adherent to the theory of natural selection from taking any view he pleases as to the importance of the direct influence of conditions and the hereditary transmissibility of the modifications which they produce. In fact, there is a good deal to be said for the view that the so-called direct influence of conditions is itself a case of selection. Whether the hypothesis of Pangenesis be accepted or rejected, it can hardly be doubted that the struggle for existence goes on not merely between distinct organisms, but between the physiological units of which each organism is [293] composed, and that changes in external conditions favour some and hinder others.

After a short stay in Cambridge, Darwin resided in London for the first five years which followed his return to England; and for three years, he held the post of Secretary to the Geological Society, though he shared to the full his friend Lyell's objection to entanglement in such engagements. In fact, he used to say in later life, more than half in earnest, that he gave up hoping for work from men who accepted official duties and, especially, Government appointments. Happily for him, he was exempted from the necessity of making any sacrifice of this kind, but an even heavier burden was laid upon him. During the earlier half of his voyage Darwin retained the vigorous health of his boyhood, and indeed proved himself to be exceptionally capable of enduring fatigue and privation. An anomalous but severe disorder, which laid him up for several weeks at Valparaiso in 1834, however, seems to have left its mark on his constitution; and, in the later years of his London life, attacks of illness, usually accompanied by severe vomiting and great prostration of strength, became frequent. As he grew older, a considerable part of every day, even at his best times, was spent in misery; while, not unfrequently, months of suffering rendered work of any kind impossible. Even Darwin's remarkable tenacity of purpose and methodical utilisation of [294] every particle of available energy could not have enabled him to achieve a fraction of the vast amount of labour he got through, in the course of the following forty years, had not the wisest and the most loving care unceasingly surrounded him from the time of his marriage in 1839. As early as 1842, the failure of health was so marked that removal from London became imperatively necessary; and Darwin purchased a house and grounds at Down, a solitary hamlet in Kent, which was his home for

the rest of his life. Under the strictly regulated conditions of a valetudinarian existence, the intellectual activity of the invalid might have put to shame most healthy men; and, so long as he could hold his head up, there was no limit to the genial kindness of thought and action for all about him. Those friends who were privileged to share the intimate life of the household at Down have an abiding memory of the cheerful restfulness which pervaded and characterised it.

After mentioning his settlement at Down, Darwin writes in his Autobiography:–

"My chief enjoyment and sole employment throughout life has been scientific work; and the excitement from such work makes me, for the time, forget, or drives quite away, my daily discomfort. I have, therefore, nothing to record during the rest of my life, except the publication of my several books." (I, p. 79.)

[295] Of such works published subsequently to 1859, several are monographic discussions of topics briefly dealt with in the "Origin," which, it must always be recollected, was considered by the author to be merely an abstract of an *opus majus.*

The earliest of the books which may be placed in this category, "On the Various Contrivances by which Orchids are Fertilised by Insects," was published in 1862, and whether we regard its theoretical significance, the excellence of the observations and the ingenuity of the reasonings which it records, or the prodigious mass of subsequent investigation of which it has been the parent, it has no superior in point of importance. The conviction that no theory of the origin of species could be satisfactory which failed to offer an explanation of the way in which mechanisms involving adaptations of structure and function to the performance of certain operations are brought about, was, from the first, dominant in Darwin's mind. As has been seen, he rejected Lamarck's views because of their obvious incapacity to furnish such an explanation in the case of the great majority of animal mechanisms, and in that of all those presented by the vegetable world.

So far back as 1793, the wonderful work of Sprengel had established, beyond any reasonable doubt, the fact that, in a large number of cases, a flower is a piece of mechanism the object of which is to convert insect visitors into agents of fertilisa[296]tion. Sprengel's observations had been most undeservedly neglected and well-nigh forgotten; but Robert Brown having directed Darwin's attention to them in 1841, he was attracted towards the subject, and verified many of Sprengel's statements. (III, p. 258.) It may be doubted whether there was a living botanical specialist, except perhaps Brown, who had done as much. If, however, adaptations of this kind were to be explained by natural selection, it was necessary to show that the plants which were provided with mechanisms for ensuring the aid of insects as fertilisers, were by so much the better fitted to compete with their rivals. This Sprengel had not done. Darwin had been attending to cross fertilisation in plants so far back as 1839, from having arrived, in the course of his speculations on the origin of species, at the conviction "that crossing played an important part in keeping specific forms constant" (I, p. 90). The further development of his views on the importance of cross fertilisation appears to have taken place between this time and 1857, when he published his first papers on the fertilisation of flowers in the "Gardener's Chronicle." If the conclusion at which he

ultimately arrived, that cross-fertilisation is favourable to the fertility of the parent and to the vigour of the offspring, is correct, then it follows that all those mechanisms which hinder self-fertilisation and favour crossing [297] must be advantageous in the struggle for existence; and, the more perfect the action of the mechanism, the greater the advantage. Thus the way lay open for the operation of natural selection in gradually perfecting the flower as a fertilisation-trap. Analogous reasoning applies to the fertilising insect. The better its structure is adapted to that of the trap, the more will it be able to profit by the bait, whether of honey or of pollen, to the exclusion of its competitors. Thus, by a sort of action and reaction, a two-fold series of adaptive modifications will be brought about.

In 1865, the important bearing of this subject on his theory led Darwin to commence a great series of laborious and difficult experiments on the fertilisation of plants, which occupied him for eleven years, and furnished him with the unexpectedly strong evidence in favour of the influence of crossing which he published in 1876, under the title of "The Effects of Cross and Self Fertilisation in the Vegetable Kingdom." Incidentally, as it were, to this heavy piece of work, he made the remarkable series of observations on the different arrangements by which crossing is favoured and, in many cases, necessitated, which appeared in the work on "The Different Forms of Flowers in Plants of the same Species" in 1877.

In the course of the twenty years during which Darwin was thus occupied in opening up new regions of investigation to the botanist and [298] showing the profound physiological significance of the apparently meaningless diversities of floral structure, his attention was keenly alive to any other interesting phenomena of plant life which came in his way. In his correspondence, he not unfrequently laughs at himself for his ignorance of systematic botany; and his acquaintance with vegetable anatomy and physiology was of the slenderest. Nevertheless, if any of the less common features of plant life came under his notice, that imperious necessity of seeking for causes which nature had laid upon him, impelled, and indeed compelled, him to inquire the how and the why of the fact, and its bearing on his general views. And as, happily, the atavic tendency to frame hypotheses was accompanied by an equally strong need to test them by well-devised experiments, and to acquire all possible information before publishing his results, the effect was that he touched no topic without elucidating it.

Thus the investigation of the operations of insectivorous plants, embodied in the work on that topic published in 1875, was started fifteen years before, by a passing observation made during one of Darwin's rare holidays.

"In the summer of 1860, I was idling and resting near Hartfield, where two species of Drosera abound; and I noticed that numerous insects had been entrapped by the leaves. I [299] carried home some plants, and on giving them some insects saw the movements of the tentacles, and this made me think it possible that the insects were caught for some special purpose. Fortunately, a crucial test occurred to me, that of placing a large number of leaves in various nitrogenous and non-nitrogenous fluids of equal density; and as soon as I found that the former alone excited energetic movements, it was obvious that here was a fine new field for investigation." (I, p. 95.)

The researches thus initiated led to the proof that plants are capable of secreting a digestive fluid like that of animals, and of profiting by the result of digestion; whereby the peculiar apparatuses of the insectivorous plants were brought within the scope of natural selection. Moreover, these inquiries widely enlarged our knowledge of the manner in which stimuli are transmitted in plants, and opened up a prospect of drawing closer the analogies between the motor processes of plants and those of animals.

So with respect to the books on "Climbing Plants" (1875), and on the "Power of Movement in Plants" (1880), Darwin says;–

"I was led to take up this subject by reading a short paper by Asa Gray, published in 1858. He sent me some seeds, and on raising some plants I was so much fascinated and perplexed by the revolving movements of the tendrils and stems, which movements are really very simple, though [300] appearing at first sight very complex, that I procured various other kinds of climbing plants and studied the whole subject.... Some of the adaptations displayed by climbing plants are as beautiful as those of orchids for ensuring cross-fertilisation." (I, p. 93.)

In the midst of all this amount of work, remarkable alike for its variety and its importance, among plants, the animal kingdom was by no means neglected. A large moiety of "The Variation of Animals and Plants under Domestication" (1868), which contains the *pièces justicatives* of the first chapter of the "Origin," is devoted to domestic animals, and the hypothesis of "pangenesis" propounded in the second volume applies to the whole living world. In the "Origin" Darwin throws out some suggestions as to the causes of variation, but he takes heredity, as it is manifested by individual organisms, for granted, as an ultimate fact; pangenesis is an attempt to account for the phenomena of heredity in the organism, on the assumption that the physiological units of which the organism is composed give off gemmules, which, in virtue of heredity, tend to reproduce the unit from which they are derived.

That Darwin had the application of his theory to the origin of the human species clearly in his mind in 1859, is obvious from a passage in the first edition of "The Origin of Species." (Ed. I, p. 488.) "In the distant future I see open fields [301] for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history." It is one of the curiosities of scientific literature, that, in the face of this plain declaration, its author should have been charged with concealing his opinions on the subject of the origin of man. But he reserved the full statement of his views until 1871, when the "Descent of Man" was published. The "Expression of the Emotions" (originally intended to form only a chapter in the "Descent of Man") grew into a separate volume, which appeared in 1872. Although always taking a keen interest in geology, Darwin naturally found no time disposable for geological work, even had his health permitted it, after he became seriously engaged with the great problem of species. But the last of his labours is, in some sense, a return to his earliest, inasmuch as it is an expansion of a short paper read before the Geological Society more than forty years before, and, as he says, "revived old geological thoughts" (I, p. 98). In fact, "The Formation of Vegetable Mould through the Action of Worms," affords as striking an example of the great results produced by the long-continued operation of small causes as even the author of the "Principles of Geology" could have desired.

In the early months of 1882 Darwin's health [302] underwent a change for the worse; attacks of giddiness and fainting supervened, and on the 19th of April he died. On the 20th, his remains were interred in Westminster Abbey, in accordance with the general feeling that such a man as he should not go to the grave without some public recognition of the greatness of his work.

Mr. Darwin became a Fellow of the Royal Society in 1839; one of the Royal Medals was awarded to him in 1853, and he received the Copley Medal in 1864. The "Life and Letters," edited with admirable skill and judgment by Mr. Francis Darwin, gives a full and singularly vivid presentment of his father's personal character, of his mode of work, and of the events of his life. In the present brief obituary notice, the writer has attempted nothing more than to select and put together those facts which enable us to trace the intellectual evolution of one of the greatest of the many great men of science whose names adorn the long roll of the Fellows of the Royal Society.

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[1] From the Obituary Notices of the *Proceedings of the Royal Society,* vol. 44.

[2] The references throughout this notice are to the *Life and Letters,* unless the contrary is expressly stated.

[3] "After my return to England it appeared to me that by following the example of Lyell in Geology, and by collecting all facts which bore in any way on the variation of animals and plants under domestication and nature, some light might perhaps be thrown on the whole subject [of the origin of species]." (I. p. 83.) See also the dedication of the second edition of the *Journal of a Naturalist.*

[4] "I had brought with me the first volume of Lyell's *Principles of Geology,* which I studied attentively; and the book was of the highest service to me in many ways. The very first place which I examined, namely, St. Jago, in the Cape de Verd Islands, showed me clearly the wonderful superiority of Lyell's manner of treating Geology, compared with that of any other author whose words I had with me or ever afterwards read "–(I. p. 62.)

[5] I am indebted to Mr. F. Darwin for the knowledge of a letter addressed by his father to Dr. Otto Zacharias in 1877 which contains the following paragraph, confirmatory of the view expressed above: "When I was on board the *Beagle,* I believed in the permanence of species but, as far as I can remember, vague doubts occasionally flitted across my mind. On my return home in the autumn of 1836, I immediately began to prepare my journal for publication, and then saw how many facts indicated the common descent of species so that in July 1837, I opened a note-book to record any facts which might bear on the question. But I did not become convinced that species were mutable until, I think, two or three years had elapsed."

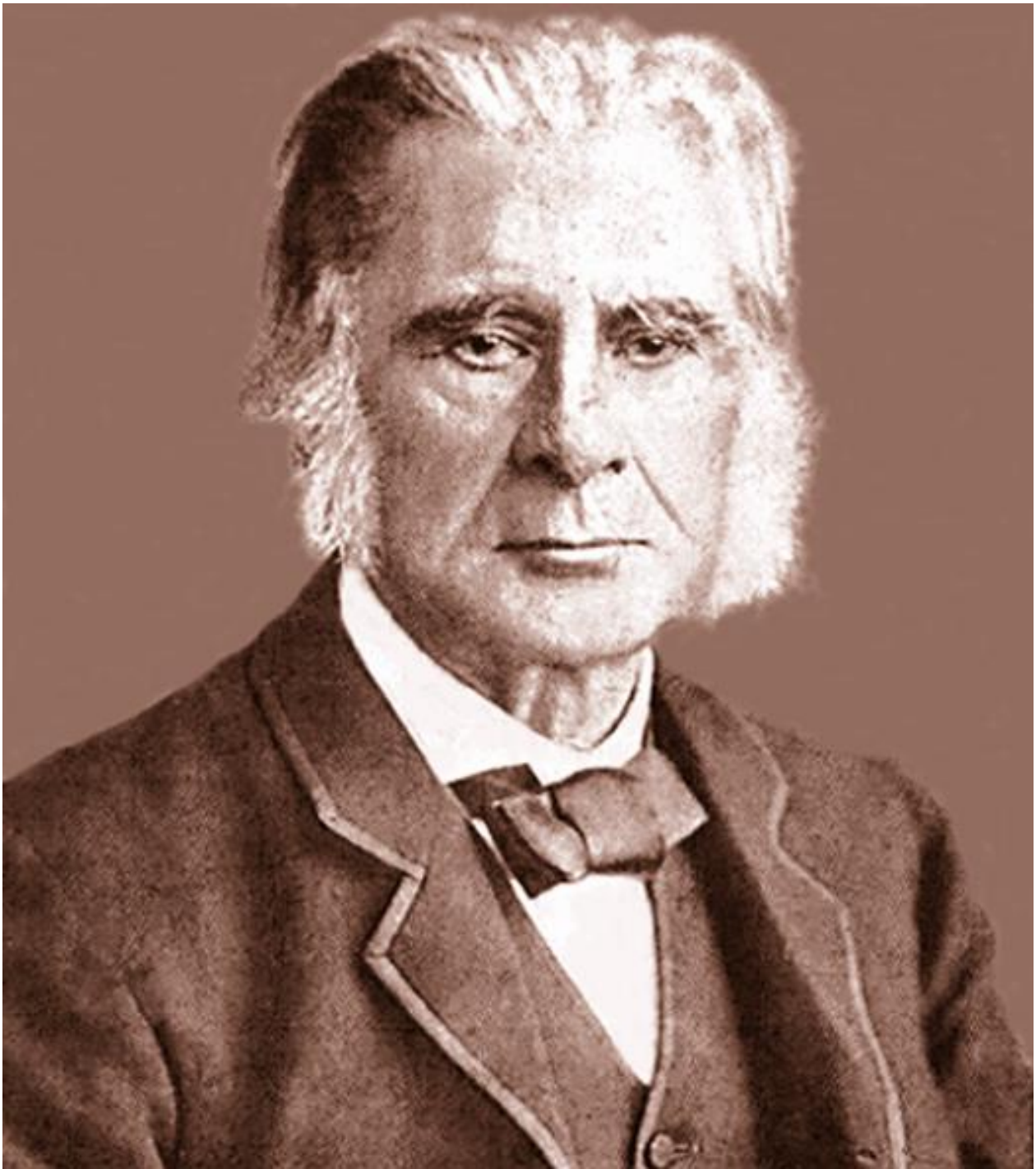
[6] Darwin generally uses the word "idle" in a peculiar sense. He means by it working hard at something he likes when he ought to be occupied with a less attractive subject. Though it sounds paradoxical, there is a good deal to be said in favour of this view of pleasant work.

[7] "After describing a set of forms as distinct species, tearing up my MS., and making them one species, tearing that up and making them separate, and then making them one again (which has happened to me), I have gnashed

my teeth, cursed species, and asked what sin I had committed to be so punished." (II. p. 40.) Is there any naturalist provided with a logical sense and a large suite of specimens, who has not undergone pangs of the sort described in this vigorous paragraph, which might, with advantage, be printed on the title-page of every systematic monograph as a warning to the uninitiated?

[8] The last remark contains a pregnant truth, but it must be confessed it hardly squares with the declaration in the *Autobiography*, (I. p. 83), that he worked on "true Baconian principles."

[9] He is comforted to find that probably the best qualified judge among all the readers of the *Origin* in 1859 was of the same opinion. Sir J. Hooker writes, "It is the very hardest book to read, to full profit, that I ever tried." (II. p. 242).

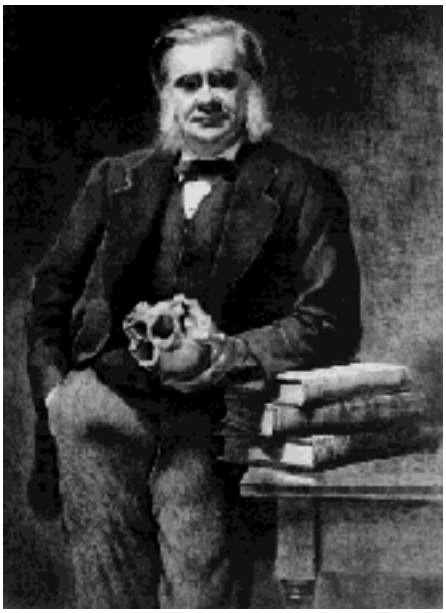


Darwin Medal

T. H. H. recipient of Royal Society

Darwin Medal 1893

London Stereoscopic



Preface and Table of Contents to Volume II, *Darwiniana*, of Huxley's *Collected Essays.*

Next article: Six Lectures to Working Men "On Our Knowledge of the Causes of the Phenomena of Organic Nature" [1863], pages 303-475.

Previous article: The Darwin Memorial [1885], pages 248-252.

C. Blinderman & D. Joyce
Clark University

On Our Knowledge of the Causes of the Phenomena of Organic Nature (1863)

Collected Essays II

[303] I

The Present Condition of Organic Nature

WHEN it was my duty to consider what subject I would select for the six lectures which I shall now have the pleasure of delivering to you, it occurred to me that I could not do better than endeavour to put before you in a true light, or in what I might perhaps with more modesty call, that which I conceive myself to be the true light, the position of a book which has been more praised and more abused, perhaps, than any book which has appeared for some years;–I mean Mr. Darwin's work on the "Origin of Species." That work, I doubt not, many of you have read; for I know the inquiring spirit which is rife among you. At any rate, all of you will have heard of it,–some by one kind of report and some by another kind of report; the [304] attention of all and the curiosity of all have been probably more or less excited on the subject of that work. All I can do, and all I shall attempt to do, is to put before you that kind of judgment which has been formed by a man, who, of course, is liable to judge erroneously; but, at any rate, of one whose business and profession it is to form judgments upon questions of this nature.

And here, as it will always happen when dealing with an extensive subject, the greater part of my course–if, indeed, so small a number of lectures can be properly called a course–must be devoted to preliminary matters, or rather to a statement of those facts and of those principles which the work itself dwells upon, and brings more or less directly before us. I have no right to suppose that all or any of you are naturalists; and, even if you were, the misconceptions and misunderstandings prevalent even among naturalists, on these matters, would make it desirable that I should take the course I now propose to take,–that I should start from the beginning,–that I should endeavour to point out what is the existing state of the organic world–that I should point out its past condition,–that I should state what is the precise nature of the undertaking which Mr. Darwin has taken in hand; that I should endeavour to show you what are the only methods by which that undertaking can be brought to an issue, and to point out to you how far the author of the work [305] in question has satisfied those conditions, how far he has not satisfied them, how far they are satisfiable by man, and how far they are not satisfiable by man.

To-night, in taking up the first part of the question, I shall endeavour to put before you a sort of broad notion of our knowledge of the condition of the living world. There are many ways of doing this. I might deal with it pictorially and graphically. Following the example of Humboldt in his "Aspects of Nature," I might endeavour to point out the infinite variety of organic life in every mode of its existence, with reference to the variations of climate and the like; and such an attempt would be fraught with interest to us all; but considering the subject before us, such a course would not be that best calculated to assist us. In an argument of this kind we must go further and dig deeper into the matter; we must endeavour to

look into the foundations of living Nature, if I may so say, and discover the principles involved in some of her most secret operations. I propose, therefore, in the first place, to take some ordinary animal with which you are all familiar, and, by easily comprehensible and obvious examples drawn from it, to show what are the kind of problems which living beings in general lay before us; and I shall then show you that the same problems are laid open to us by all kinds of living beings. But first, let me say in what sense I have used the [306] words "organic nature." In speaking of the causes which lead to our present knowledge of organic nature, I have used it almost as an equivalent of the word "living," and for this reason,–that in almost all living beings you can distinguish several distinct portions set apart to do particular things and work in a particular way. These are termed "organs," and the whole together is called "organic." And as it is universally characteristic of them, the term "organic" has been very conveniently employed to denote the whole of living nature,–the whole of the plant world, and the whole of the animal world.

Few animals can be more familiar to you than that whose skeleton is shown on our diagram. You need not bother yourselves with this "*Equus caballus*" written under it; that is only the Latin name of it, and does not make it any better. It simply means the common horse. Suppose we wish to understand all about the horse. Our first object must be to study the structure of the animal. The whole of his body is inclosed within a hide, a skin covered with hair; and if that hide or skin be taken off, we find a great mass of flesh, or what is technically called muscle, being the substance which by its power of contraction enables the animal to move. These muscles move the hard parts one upon the other, and so give that strength and power of motion which renders the horse so [307] useful to us in the performance of those services in which we employ him.

And then, on separating and removing the whole of this skin and flesh, you have a great series of bones, hard structures, bound together with ligaments, and forming the skeleton which is represented here.

In that skeleton there are a number of parts to be recognised. The long series of bones, beginning from the skull and ending in the tail, is called the spine, and those in front are the ribs; and then there are two pairs of limbs, one before and one behind; and there are what we all know as the fore-legs and the hind-legs. If we pursue our researches into the interior of this animal, we find within the framework of the skeleton a great cavity, or rather, I should say, two great cavities,–one cavity beginning in the skull and running through the neck-bone, along the spine, and ending in the tail, containing the brain and the spinal marrow, which are extremely important organs. The second great cavity, commencing with the mouth, contains the gullet, the stomach, the long intestine, and all the rest of those internal apparatus which are essential for digestion; and then in the same great cavity, there are lodged the heart and all the great vessels going from it; and, besides that the organs of respiration–the lungs: and then the kidneys, and the organs of reproduction, and so on. Let us now endeavour to [308] reduce this notion of a horse that we now have, to some such kind of simple expressions as can be at once, and without difficulty, retained in the mind, apart from all minor details. If I make a transverse section, that is, if I were to saw a dead horse across, I should find that, if I left out the details, and supposing I took my section through the anterior region, and through the fore-limbs, I should have here this kind of section of the body (Fig. 1). Here would be the upper part of the animal–that great mass of bones that we spoke of as the spine (*a*, Fig. 1). Here I should have the alimentary canal (*b*, Fig. 1).

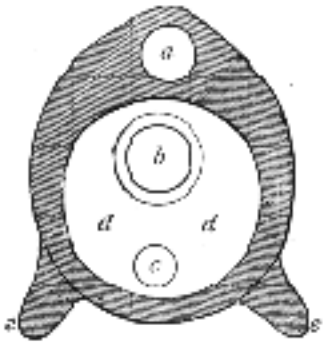


Fig. 1.

Here I should have the heart (*c*, Fig. l); and then you see, there would be a kind of double tube, the whole being inclosed within the hide; the spinal marrow would be placed in the upper tube (*a*, Fig. 1), and in the lower tube (*dd*, Fig. 1), there would be the alimentary canal (*b*), and the heart (*c*); and here I shall have the legs proceeding from each side. For simplicity's sake, I represent them merely as [309] stumps (*e e*, Fig. 1). Now that is a horse–as mathematicians would say–reduced to its most simple expression. Carry that in your minds, if you please, as a simplified idea of the structure of the horse. The considerations which I have now put before you belong to what we technically call the "Anatomy" of the horse. Now, suppose we go to work upon these general parts,–flesh and hair, and skin and bone, and lay open these various organs with our scalpels, and examine them by means of our magnifying-glasses, and see what we can make of them. We shall find that the flesh is made up of bundles of strong fibres. The brain and nerves, too, we shall find, are made up of fibres, and these queer-looking things that are called ganglionic corpuscles. If we take a slice of the bone and examine it, we shall find that it is very like this diagram of a section of the bone of an ostrich, though differing, of course, in some details; and if we take any part whatsoever of the tissue, and examine it, we shall find it all has a minute structure, visible only under the microscope. All these parts constitute microscopic anatomy or "Histology." These parts are constantly being changed; every part is constantly growing, decaying, and being replaced during the life of the animal. The tissue is constantly replaced by new material; and if you go back to the young state of the tissue in the case of muscle, or in the case of skin, or any of the organs I have mentioned, you will find that [310] they all come under the same condition. Every one of these microscopic filaments and fibres (I now speak merely of the general character of the whole process)–every one of these parts–could be traced down to some modification of a tissue which can be readily divided into little particles of fleshy matter, of that substance which is composed of the chemical elements, carbon, hydrogen, oxygen, and nitrogen, having such a shape as this (Fig. 2).

Fig. 2.

These particles, into which all primitive tissues break up, are called cells. If I were to make a section of a piece of the skin of my hand, I should find that it was made up of these cells. If I examine the fibres which form the various organs of all living animals, I should find that all of them, at one time or other, had been formed out of a substance consisting of similar elements; so that you see, just as we reduced the whole body in the gross to that sort of simple expression given in Fig. 1, so we may reduce the whole of the microscopic structural elements to a form of even greater simplicity; just as the plan of the whole body may be so represented in a sense (Fig. 1), so the primary structure of every tissue may be represented by a mass of cells (Fig. 2).

Having thus, in this sort of general way, sketched to you what I may call, perhaps, the architecture of the body of the horse (what we [311] term technically its Morphology), I must now turn to another aspect. A horse is not a mere dead structure: it is an active, living, working machine. Hitherto we have, as it were, been looking at a steam-engine with the fires out, and nothing in the boiler; but the body of the living animal is a beautifully-formed active machine, and every part has its different work to do in the working of that machine, which is what we call its life. The horse, if you see him after his day's work is done, is cropping the grass in the fields, as it may be, or munching the oats in his stable. What is he doing? His jaws are working as a mill–and a very complex mill too–grinding the corn, or crushing the grass to a pulp. As soon as that operation has taken place, the food is passed down to the stomach, and there it is mixed with the chemical fluid called the gastric juice, a substance which has the peculiar property of making soluble and dissolving out the nutritious matter in the grass, and leaving behind those parts which are not nutritious; so that you have, first, the mill, then a sort of chemical digester; and then the food, thus partially dissolved, is carried back by the muscular contractions of the intestines into the hinder parts of the body, while the soluble portions are taken up into the blood. The blood is contained in a vast system of pipes, spreading through the whole body, connected with a force pump,–the heart,–which, by its position and by [312] the contractions of its valves, keeps the blood constantly circulating in one direction, never allowing it to rest; and then, by means of this circulation of the blood, laden as it is with the products of digestion, the skin, the flesh, the hair, and every other part of the body, draws from it that which it wants, and every one of these organs derives those materials which are necessary to enable it to do its work.

The action of each of these organs, the performance of each of these various duties, involve in their operation a continual absorption of the matters necessary for their support, from the blood, and a constant formation of waste products, which are returned to the blood, and conveyed by it to the lungs and the kidneys, which are organs that have allotted to them the office of extracting, separating, and getting rid of these waste products; and thus the general nourishment, labour, and repair of the whole machine are kept up with order and regularity. But not only is it a machine which feeds and appropriates to its own support the nourishment necessary to its existence–it is an engine for locomotive purposes. The horse desires to go from one place to another; and to enable it to do this, it has those strong contractile bundles of muscles attached to the bones of its limbs, which are put in motion by means of a sort of telegraphic apparatus formed by the brain and the great spinal cord running through the spine or [313] backbone; and to this spinal cord are attached a number of fibres termed nerves, which proceed to all parts of the structure. By means of these the eyes, nose, tongue, and skin–all the organs of perception–transmit impressions or sensations to the brain, which acts as a sort of great central telegraph-

office, receiving impressions and sending messages to all parts of the body, and putting in motion the muscles necessary to accomplish any movement that may be desired. So that you have here an extremely complex and beautifully-proportioned machine, with all its parts working harmoniously together towards one common object–the preservation of the life of the animal.

Now, note this: the horse makes up its waste by feeding, and its food is grass or oats, or perhaps other vegetable products; therefore, in the long run, the source of all this complex machinery lies in the vegetable kingdom. But where does the grass, or the oat, or any other plant, obtain this nourishing food-producing material? At first it is a little seed, which soon begins to draw into itself from the earth and the surrounding air matters which in themselves contain no vital properties whatever; it absorbs into its own substance water, an inorganic body; it draws into its substance carbonic acid, an inorganic matter; and ammonia, another inorganic matter, found in the air; and then, by some wonderful chemical process, the [314] details of which chemists do not yet understand, though they are near foreshadowing them, it combines them into one substance, which is known to us as "Protein," a complex compound of carbon, hydrogen, oxygen, and nitrogen, which alone possesses the property of manifesting vitality and of permanently supporting animal life. So that, you see, the waste products of the animal economy, the effete materials which are continually being thrown off by all living beings, in the form of organic matters, are constantly replaced by supplies of the necessary repairing and rebuilding materials drawn from the plants, which in their turn manufacture them, so to speak, by a mysterious combination of those same inorganic materials.

Let us trace out the history of the horse in another direction. After a certain time, as the result of sickness or disease, the effect of accident, or the consequence of old age, sooner or later, the animal dies. The multitudinous operations of this beautiful mechanism flag in their performance, the horse loses its vigour, and after passing through the curious series of changes comprised in its formation and preservation, it finally decays, and ends its life by going back into that inorganic world from which all but an inappreciable fraction of its substance was derived. Its bones become mere carbonate and phosphate of lime; the matter of its flesh, and of its other parts, becomes, in the [315] long run, converted into carbonic acid, into water, and into ammonia. You will now, perhaps, understand the curious relation of the animal with the plant, of the organic with the inorganic world, which is shown in this diagram.

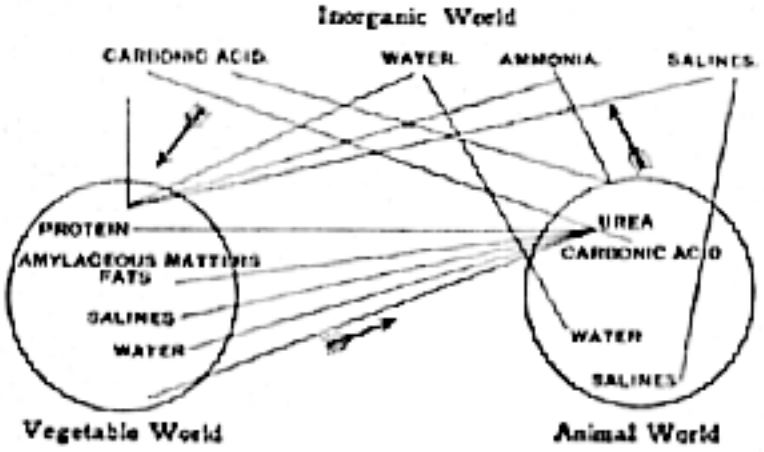


Fig. 3.

The plant gathers these inorganic materials together and makes them up into its own substance. The animal eats the plant and appropriates the nutritious portions to its own sustenance, rejects and gets rid of the useless matters; and, finally, the animal itself dies, and its whole body is decomposed and returned into the inorganic world. There is thus a constant circulation from one to the other, a continual formation of organic life from inorganic matters, and as constant a return of the matter of living bodies to the inorganic world; so that the materials of which [316] our bodies are composed are largely, in all probability, the substances which constituted the matter of long extinct creations, but which have in the interval constituted a part of the inorganic world.

Thus we come to the conclusion, strange at first sight, that the Matter constituting the living world is identical with that which forms the inorganic world. And not less true is it that, remarkable as are the powers or, in other words, as are the Forces which are exerted by living beings, yet all these forces are either identical with those which exist in the inorganic world, or they are convertible into them; I mean in just the same sense as the researches of physical philosophers have shown that heat is convertible into electricity, that electricity is convertible into magnetism, magnetism into mechanical force or chemical force, and any one of them with the other, each being measurable in terms of the other,–even so, I say, that great law is applicable to the living world. Consider why is the skeleton of this horse capable of supporting the masses of flesh and the various organs forming the living body, unless it is because of the action of the same forces of cohesion which combines together the particles of matter composing this piece of chalk? What is there in the muscular contractile power of the animal but the force which is expressible, and which is in a certain sense convertible, into [317] the force of gravity which it overcomes? Or, if you go to more hidden processes, in what does the process of digestion differ from those processes which are carried on in the laboratory of the chemist? Even if we take the most recondite and most complex operations of animal life–those of the nervous system, these of late years have been shown to be–I do not say identical in any sense with the electrical processes–but this has been shown, that they are in some way or other associated with them; that is to say, that every amount of nervous action is accompanied by a certain amount of electrical disturbance in the particles of the nerves in which that nervous action is carried on. In this way the nervous action is related to electricity in the same

way that heat is related to electricity; and the same sort of argument which demonstrates the two latter to be related to one another shows that the nervous forces are correlated to electricity; for the experiments of M. Dubois Reymond and others have shown that whenever a nerve is in a state of excitement, sending a message to the muscles or conveying an impression to the brain, there is a disturbance of the electrical condition of that nerve which does not exist at other times; and there are a number of other facts and phenomena of that sort; so that we come to the broad conclusion that not only as to living matter itself, but as to the forces that matter exerts, there is a close [318] relationship between the organic and the inorganic world–the difference between them arising from the diverse combination and disposition of identical forces, and not from any primary diversity, so far as we can see.

I said just now that the horse eventually died and became converted into the same inorganic substances from whence all but an inappreciable fraction of its substance demonstrably originated, so that the actual wanderings of matter are as remarkable as the transmigrations of the soul fabled by Indian tradition. But before death has occurred, in the one sex or the other, and in fact in both, certain products or parts of the organism have been set free, certain parts of the organisms of the two sexes have come into contact with one another, and from that conjunction, from that union which then takes place, there results the formation of a new being. At stated times the mare, from a particular part of the interior of her body, called the ovary, gets rid of a minute particle of matter comparable in all essential respects with that which we called a cell a little while since, which cell contains a kind of nucleus in its centre, surrounded by a clear space and by a viscid mass of protein substance (Fig. 2); and though it is different in appearance from the eggs which we are mostly acquainted with, it is really an egg. After a time this minute particle of matter, which may only be a small fraction of a [319] grain in weight, undergoes a series of changes,–wonderful, complex changes. Finally, upon its surface there is fashioned a little elevation, which afterwards becomes divided and marked by a groove. The lateral boundaries of the groove extend upwards and downwards, and at length give rise to a double tube. In the upper and smaller tube the spinal marrow and brain are fashioned; in the lower, the alimentary canal and heart; and at length two pairs of buds shoot out at the sides of the body, and they are the rudiments of the limbs. In fact a true drawing of a section of the embryo in this state would in all essential respects resemble that diagram of a horse reduced to its simplest expression, which I first placed before you (Fig. 1).

Slowly and gradually these changes take place. The whole of the body, at first, can be broken up into "cells," which become in one place metamorphosed into muscle,–in another place into gristle and bone,–in another place into fibrous tissue,–and in another into hair; every part becoming gradually and slowly fashioned, as if there were an artificer at work in each of these complex structures that I have mentioned. This embryo, as it is called, then passes into other conditions. I should tell you that there is a time when the embryos of neither dog, nor horse, nor porpoise, nor monkey, nor man, can be distinguished by any essential feature one from the other; there is a [320] time when they each and all of them resemble this one of the dog. But as development advances, all the parts acquire their speciality, till at length you have the embryo converted into the form of the parent from which it started. So that you see, this living animal, this horse, begins its existence as a minute particle of nitrogenous matter, which, being supplied with nutriment (derived, as I have shown, from the inorganic world), grows up according to the special type and construction of its parents, works and undergoes a constant waste, and that waste is made good by nutriment derived from the inorganic world; the waste given off in this way

being directly added to the inorganic world. Eventually the animal itself dies, and, by the process of decomposition, its whole body is returned to those conditions of inorganic matter in which its substance originated.

This, then, is that which is true of every living form, from the lowest plant to the highest animal–to man himself. You might define the life of every one in exactly the same terms as those which I have now used; the difference between the highest and the lowest being simply in the complexity of the developmental changes, the variety of the structural forms, and the diversity of the physiological functions which are exerted by each.

If I were to take an oak tree, as a specimen of [321] the plant world, I should find that it originated in an acorn, which, too, commenced in a cell; the acorn is placed in the ground, and it very speedily begins to absorb the inorganic matters I have named, adds enormously to its bulk, and we can see it, year after year, extending itself upward and downward, attracting and appropriating to itself inorganic materials, which it vivifies, and eventually, as it ripens, gives off its own proper acorns, which again run the same course. But I need not multiply examples,–from the highest to the lowest the essential features of life are the same as I have described in each of these cases.

So much, then, for these particular features of the organic world, which you can understand and comprehend, so long as you confine yourself to one sort of living being, and study that only.

But, as you know, horses are not the only living creatures in the world; and again, horses, like all other animals, have certain limits–are confined to a certain area on the surface of the earth on which we live,–and, as that is the simpler matter, I may take that first. In its wild state, and before the discovery of America, when the natural state of things was interfered with by the Spaniards, the horse was only to be found in parts of the earth which are known to geographers as the Old World; that is to say, you might meet with horses in Europe, Asia, or Africa; but there were none in Australia, and there were none whatsoever [322] in the whole continent of America, from Labrador down to Cape Horn. This is an empirical fact, and it is what is called, stated in the way I have given it you, the "Geographical Distribution" of the horse.

Why horses should be found in Europe, Asia, and Africa, and not in America, is not obvious; the explanation that the conditions of life in America are unfavourable to their existence, and that, therefore, they had not been created there, evidently does not apply; for when the invading Spaniards, or our own yeomen farmers, conveyed horses to these countries for their own use, they were found to thrive well and multiply very rapidly; and many are even now running wild in those countries, and in a perfectly natural condition. Now, suppose we were to do for every animal what we have here done for the horse,–that is, to mark off and distinguish the particular district or region to which each belonged; and supposing we tabulated all these results, that would be called the Geographical Distribution of animals, while a corresponding study of plants would yield as a result the Geographical Distribution of plants.

I pass on from that now, as I merely wished to explain to you what I meant by the use of the term

"Geographical Distribution." As I said, there is another aspect, and a much more important one, and that is, the relations of the various [323] animals to one another. The horse is a very well-defined matter-of-fact sort of animal, and we are all pretty familiar with its structure. I dare say it may have struck you, that it resembles very much no other member of the animal kingdom, except perhaps the zebra or the ass. But let me ask you to look along these diagrams. Here is the skeleton of the horse, and here the skeleton of the dog. You will notice that we have in the horse a skull, a backbone and ribs, shoulder-blades and haunch-bones. In the fore-limb, one upper arm-bone, two fore arm-bones, wrist-bones (wrongly called knee), and middle hand-bones, ending in the three bones of a finger, the last of which is sheathed in the horny hoof of the fore-foot: in the hind-limb, one thigh-bone, two leg-bones, anklebones, and middle foot-bones, ending in the three bones of a toe, the last of which is encased in the hoof of the hind-foot. Now turn to the dog's skeleton. We find identically the same bones, but more of them, there being more toes in each foot, and hence more toe-bones.

Well, that is a very curious thing! The fact is that the dog and the horse–when one gets a look at them without the outward impediments of the skin–are found to be made in very much the same sort of fashion. And if I were to make a transverse section of the dog, I should find the same organs that I have already shown you as forming parts of the horse. Well, here is another [324] skeleton–that of a kind of lemur–you see he has just the same bones; and if I were to make a transverse section of it, it would be just the same again. In your mind's eye turn him round, so as to put his backbone in a position inclined obliquely upwards and forwards, just as in the next three diagrams, which represent the skeletons of an orang, a chimpanzee, and a gorilla, and you find you have no trouble in identifying the bones throughout; and lastly turn to the end of the series, the diagram representing a man's skeleton, and still you find no great structural feature essentially altered. There are the same bones in the same relations. From the horse we pass on and on, with gradual steps until we arrive at last at the highest known forms. On the other hand, take the other line of diagrams, and pass from the horse downwards in the scale to this fish; and still, though the modifications are vastly greater, the essential framework of the organisation remains unchanged. Here, for instance, is a porpoise: here is its strong backbone, with the cavity running through it, which contains the spinal cord; here are the ribs, here the shoulder blade; here is the little short upper-arm bone, here are the two forearm bones, the wrist-bone, and the finger-bones.

Strange, is it not, that the porpoise should have in this queer-looking affair–its flapper (as it is called), the same fundamental elements as the [325] fore-leg of the horse or the dog, or the ape or man; and here you will notice a very curious thing,–the hinder limbs are absent, Now, let us make another jump. Let us go to the codfish: here you see is the forearm, in this large pectoral fin–carrying your mind's eye onward from the flapper of the porpoise. And here you have the hinder limbs restored in the shape of these ventral fins. If I were to make a transverse section of this, I should find just the same organs that we have before noticed. So that, you see, there comes out this strange conclusion as the result of our investigations, that the horse, when examined and compared with other animals, is found by no means to stand alone in Nature; but that there are an enormous number of other creatures which have backbones, ribs, and legs, and other parts arranged in the same general manner, and in all their formation exhibiting the same broad peculiarities.

I am sure that you cannot have followed me even in this extremely elementary exposition of the

structural relations of animals, without seeing what I have been driving at all through, which is, to show you that, step by step, naturalists have come to the idea of a unity of plan, or conformity of construction, among animals which appeared at first sight to be extremely dissimilar.

And here you have evidence of such a unity of plan among all the animals which have backbones, [326] and which we technically call *Vertebrata.* But there are multitudes of other animals, such as crabs, lobsters, spiders, and so on, which we term *Annulosa.* In these I could not point out to you the parts that correspond with those of the horse,–the backbone, for instance,–as they are constructed upon a very different principle, which is also common to all of them; that is to say, the lobster, the spider, and the centipede, have a common plan running through their whole arrangement, in just the same way that the horse, the dog, and the porpoise assimilate to each other.

Yet other creatures–whelks, cuttlefishes, oysters, snails, and all their tribe (*Mollusca*)–resemble one another in the same way, but differ from both *Vertebrata* and *Annulosa;* and the like is true of the animals called *Cœlenterata* (Polypes) and *Protozoa* (animalcules and sponges).

Now, by pursuing this sort of comparison, naturalists have arrived at the conviction that there are,–some think five, and some seven,–but certainly not more than the latter number–and perhaps it is simpler to assume five–distinct plans or constructions in the whole of the animal world; and that the hundreds of thousands of species of creatures on the surface of the earth, are all reducible to those five, or, at most, seven, plans of organisation.

But can we go no further than that? When one has got so far, one is tempted to go on a step [327] and inquire whether we cannot go back yet further and bring down the whole to modifications of one primordial unit. The anatomist cannot do this; but if he call to his aid the study of development, he can do it. For we shall find that, distinct as those plans are, whether it be a porpoise or man, or lobster, or any of those other kinds I have mentioned, every one begins its existence with one and the same primitive form,–that of the egg, consisting, as we have seen, of a nitrogenous substance, having a small particle or nucleus in the centre of it. Furthermore, the earlier changes of each are substantially the same. And it is in this that lies that true "unity of organisation" of the animal kingdom which has been guessed at and fancied for many years; but which it has been left to the present time to be demonstrated by the careful study of development. But is it possible to go another step further still, and to show that in the same way the whole of the organic world is reducible to one primitive condition of form? Is there among the plants the same primitive form of organisation, and is that identical with that of the animal kingdom? The reply to that question, too, is not uncertain or doubtful. It is now proved that every plant begins its existence under the same form; that is to say, in that of a cell–a particle of nitrogenous matter having substantially the same conditions. So that if you trace back the oak to its first [328] germ, or a man, or a horse, or lobster, or oyster, or any other animal you choose to name, you shall find each and all of these commencing their existence in forms essentially similar to each other; and, furthermore, that the first processes of growth, and many of the subsequent modifications, are essentially the same in principle in almost all.

In conclusion, let me, in a few words, recapitulate the positions which I have laid down. And you must understand that I have not been talking mere theory; I have been speaking of matters which are as plainly demonstrable as the commonest propositions of Euclid–of facts that must form the basis of all speculations and beliefs in Biological science. We have gradually traced down all organic forms, or, in other words, we have analysed the present condition of animated nature, until we found that each species took its origin in a form similar to that under which all the others commenced their existence. We have found the whole of the vast array of living forms with which we are surrounded, constantly growing, increasing, decaying and disappearing; the animal constantly attracting, modifying, and applying to its sustenance the matter of the vegetable kingdom, which derived its support from the absorption and conversion of inorganic matter. And so constant and universal is this absorption, waste, and reproduction, that it may be said with perfect certainty that there is left in no one of our bodies at the [329] present moment a millionth part of the matter of which they were originally formed! We have seen, again, that not only is the living matter derived from the inorganic world, but that the forces of that matter are all of them correlative with and convertible into those of inorganic nature.

This, for our present purposes, is the best view of the present condition of organic nature which I can lay before you: it gives you the great outlines of a vast picture, which you must fill up by your own study.

In the next lecture I shall endeavour in the same way to go back into the past, and to sketch in the same broad manner the history of life in epochs preceding our own.

[330] II

The Past Condition of Organic Nature

In the lecture which I delivered last Monday evening, I endeavoured to sketch in a very brief manner, but as well as the time at my disposal would permit, the present condition of organic nature, meaning by that large title simply an indication of the great, broad, and general principles which are to be discovered by those who look attentively at the phenomena of organic nature as at present displayed. The general result of our investigations might be summed up thus: we found that the multiplicity of the forms of animal life, great as that may be, may be reduced to a comparatively few primitive plans or types of construction; that a further study of the development of those different forms revealed to us that they were again reducible, until we at last brought the infinite diversity of animal, and even vegetable life, down to the primordial form of a single cell.

[331] We found that our analysis of the organic world, whether animals or plants, showed, in the long run, that they might both be reduced into, and were, in fact, composed of, the same constituents. And we saw that the plant obtained the materials constituting its substance by a peculiar combination of matters belonging entirely to the inorganic world; that, then, the animal was constantly appropriating the nitrogenous matters of the plant to its own nourishment, and returning them back to the inorganic world, in what we spoke of as its waste; and that finally, when the animal ceased to exist, the constituents of its body were dissolved and transmitted to that inorganic world whence they had been at first abstracted.

Thus we saw in both the blade of grass and the horse but the same elements differently combined and arranged. We discovered a continual circulation going on,–the plant drawing in the elements of inorganic nature and combining them into food for the animal creation; the animal borrowing from the plant the matter for its own support, giving off during its life products which returned immediately to the inorganic world; and that, eventually, the constituent materials of the whole structure of both animals and plants were thus returned to their original source: there was a constant passage from one state of existence to another, and a returning back again.

Lastly, when we endeavoured to form some [332] notion of the nature of the forces exercised by living beings, we discovered that they–if not capable of being subjected to the same minute analysis as the constituents of those beings themselves–that they were correlative with–that they were the equivalents of the forces of inorganic nature–that they were, in the sense in which the term is now used, convertible with them. That was our general result.

And now, leaving the Present, I must endeavour in the same manner to put before you the facts that are to be discovered in the Past history of the living world, in the past conditions of organic nature. We have, to-night, to deal with the facts of that history–a history involving periods of time before which our mere human records sink into utter insignificance–a history the variety and physical magnitude of whose events cannot even be foreshadowed by the history of human life and human phenomena–a history of the most varied and complex character.

We must deal with the history, then, in the first place, as we should deal with all other histories. The historical student knows that his first business should be to inquire into the validity of his evidence, and the nature of the record in which the evidence is contained, that he may be able to form a proper estimate of the correctness of the conclusions which have been drawn from that evidence. So, here, we must pass, in the first [333] place, to the consideration of a matter which may seem foreign to the question under discussion. We must dwell upon the nature of the records, and the credibility of the evidence they contain; we must look to the completeness or incompleteness of those records themselves, before we turn to that which they contain and reveal. The question of the credibility of the history, happily for us, will not require much consideration, for, in this history, unlike those of human origin, there can be no cavilling, no differences as to the reality and truth of the facts of which it is made up; the facts state themselves, and are laid out clearly before us.

But, although one of the greatest difficulties of the historical student is cleared out of our path, there are other difficulties–difficulties in rightly interpreting the facts as they are presented to us–which may be compared with the greatest difficulties of any other kinds of historical study.

What is this record of the past history of the globe, and what are the questions which are involved in an inquiry into its completeness or incompleteness? That record is composed of mud; and the question which we have to investigate this evening resolves itself into a question of the formation of mud. You may think, perhaps, that this is a vast step–of almost from the sublime to the ridiculous–from the contemplation of the history of the past ages of the world's [334] existence to the consideration of the

history of the formation of mud! But, in Nature, there is nothing mean and unworthy of attention; there is nothing ridiculous or contemptible in any of her works; and this inquiry, you will soon see, I hope, takes us to the very root and foundations of our subject.

How, then, is mud formed? Always, with some trifling exceptions, which I need not consider now–always, as the result of the action of water, wearing down and disintegrating the surface of the earth and rocks with which it comes in contact–pounding and grinding it down, and carrying the particles away to places where they cease to be disturbed by this mechanical action, and where they can subside and rest. For the ocean, urged by winds, washes, as we know, a long extent of coast, and every wave, loaded as it is with particles of sand and gravel as it breaks upon the shore, does something towards the disintegrating process. And thus, slowly but surely, the hardest rocks are gradually ground down to a powdery substance; and the mud thus formed, coarser or finer, as the case may be, is carried by the rush of the tides, or currents, till it reaches the comparatively deeper parts of the ocean, in which it can sink to the bottom, that is, to parts where there is a depth of about fourteen or fifteen fathoms, a depth at which the water is, usually, nearly motionless, and in which, of course, the [335] finer particles of this detritus, or mud as we call it, sinks to the bottom.

Or, again, if you take a river, rushing down from its mountain sources, brawling over the stones and rocks that intersect its path, loosening, removing, and carrying with it in its downward course the pebbles and lighter matters from its banks, it crushes and pounds down the rocks and earths in precisely the same way as the wearing action of the sea waves. The matters forming the deposit are torn from the mountain-side and whirled impetuously into the valley, more slowly over the plain, thence into the estuary, and from the estuary they are swept into the sea. The coarser and heavier fragments are obviously deposited first, that is, as soon as the current begins to lose its force by becoming amalgamated with the stiller depths of the ocean, but the finer and lighter particles are carried further on, and eventually deposited in a deeper and stiller portion of the ocean.

It clearly follows from this that mud gives us a chronology; for it is evident that supposing this, which I now sketch, to be the sea bottom, and supposing this to be a coast-line; from the washing action of the sea upon the rock, wearing and grinding it down into a sediment of mud, the mud will be carried down, and, at length, deposited in the deeper parts of this sea bottom, where it will form a layer; and then, while that first layer is [336] hardening, other mud which is coming from the same source will, of course, be carried to the same place; and, as it is quite impossible for it to get beneath the layer already there, it deposits itself above it, and forms another layer, and in that way you gradually have layers of mud constantly forming and hardening one above the other, and conveying a record of time.

It is a necessary result of the operation of the law of gravitation that the uppermost layer shall be the youngest and the lowest the oldest, and that the different beds shall be older at any particular point or spot in exactly the ratio of their depth from the surface. So that if they were upheaved afterwards, and you had a series of these different layers of mud, converted into sandstone, or limestone, as the case might be, you might be sure that the bottom layer was deposited first, and that the upper layers were formed afterwards. Here, you see, is the first step in the history–these layers of mud give us an idea of time.

The whole surface of the earth,–I speak broadly, and leave out minor qualifications,–is made up of such layers of mud, so hard, the majority of them, that we call them rock whether limestone or sandstone, or other varieties of rock. And, seeing that every part of the crust of the earth is made up in this way, you might think that the determination of the chronology, the fixing of the time which it has taken to form this [337] crust is a comparatively simple matter. Take a broad average, ascertain how fast the mud is deposited upon the bottom of the sea, or in the estuary of rivers; take it to be an inch, or two, or three inches a year, or whatever you may roughly estimate it at; then take the total thickness of the whole series of stratified rocks, which geologists estimate at twelve or thirteen miles, or about seventy thousand feet, make a sum in short division, divide the total thickness by that of the quantity deposited in one year, and the result will, of course, give you the number of years which the crust has taken to form.

Truly, that looks a very simple process! It would be so except for certain difficulties, the very first of which is that of finding how rapidly sediments are deposited; but the main difficulty–a difficulty which renders any certain calculations of such a matter out of the question–is this, the sea-bottom on which the deposit takes place is continually shifting.

Instead of the surface of the earth being that stable, fixed thing that it is popularly believed to be, being, in common parlance, the very emblem of fixity itself, it is incessantly moving, and is, in fact, as unstable as the surface of the sea, except that its undulations are infinitely slower and enormously higher and deeper.

Now, what is the effect of this oscillation? Take the case to which I have previously [338] referred. The finer or coarser sediments that are carried down by the current of the river, will only be carried out a certain distance, and eventually, as we have already seen, on reaching the stiller part of the ocean, will be deposited at the bottom.

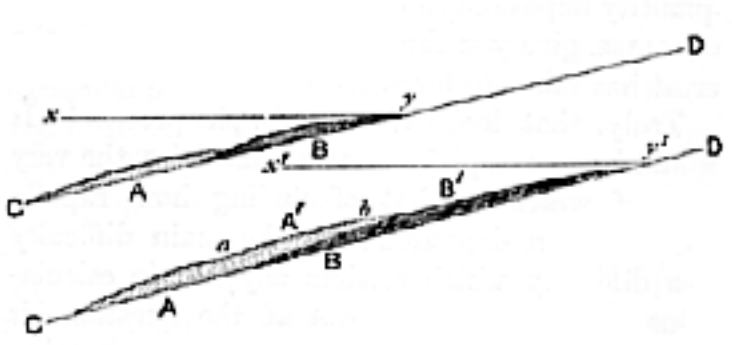


Fig. 4.

Let C *y* (Fig. 4) be the sea-bottom, *y* D the shore, *x y* the sea-level, then the coarser deposit will subside over the region B, the finer over A, while beyond A there will be no deposit at all; and, consequently, no record will be kept, simply because no deposit is going on. Now, suppose that the whole land, C, D,

which we have regarded as stationary, goes down, as it does so, both A and B go further out from the shore, which will be at y^{l}; x^{1}, y^{1}, being the new sea-level. The consequence will be that the layer of mud (A), being now, for the most part, further than the force of the current is strong enough to convey even the finest *débris*, will, of course, receive no more [339] deposits, and having attained a certain thickness will now grow no thicker.

We should be misled in taking the thickness of that layer, whenever it may be exposed to our view, as a record of time in the manner in which we are now regarding this subject, as it would give us only an imperfect and partial record: it would seem to represent too short a period of time.

Suppose, on the other hand, that the land (C D) had gone on rising slowly and gradually–say an inch or two inches in the course of a century,–what would be the practical effect of that movement? Why, that the sediment A and B which has been already deposited, would eventually be brought nearer to the shore-level and again subjected to the wear and tear of the sea; and directly the sea begins to act upon it, it would of course soon cut up and carry it way, to a greater or less extent, to be re-deposited further out.

Well, as there is, in all probability, not one single spot on the whole surface of the earth, which has not been up and down in this way a great many times, it follows that the thickness of the deposits formed at any particular spot cannot be taken (even supposing we had at first obtained correct data as to the rate at which they took place), as affording reliable information as to the period of time occupied in its deposit. So that you see it is absolutely necessary from these facts, seeing that [340] our record entirely consists of accumulations of mud, superimposed one on the other; seeing in the next place that any particular spots on which accumulations have occurred, have been constantly moving up and down, and sometimes out of the reach of a deposit, and at other times its own deposit broken up and carried away, it follows that our record must be in the highest degree imperfect, and we have hardly a trace left of thick deposits, or any definite knowledge of the area that they occupied, in a great many cases. And mark this! That supposing even that the whole surface of the earth had been accessible to the geologist,–that man had had access to every part of the earth, and had made sections of the whole, and put them all together,–even then his record must of necessity be imperfect.

But to how much has man really access? If you will look at this map you will see that it represents the proportion of the sea to the earth: this coloured part indicates all the dry land, and this other portion is the water. You will notice at once that the water covers three-fifths of the whole surface of the globe, and has covered it in the same manner ever since man has kept any record of his own observations, to say nothing of the minute period during which he has cultivated geological inquiry. So that three-fifths of the surface of the earth is shut out from us because it is under the sea. Let us look at the other [341] two-fifths, and see what are the countries in which anything that may be termed searching geological inquiry has been carried out: a good deal of France, Germany, and Great Britain and Ireland, bits of Spain, of Italy, and of Russia, have been examined, but of the whole great mass of Africa, except parts of the southern extremity, we know next to nothing; little bits of India, but of the greater part of the Asiatic continent nothing; bits of the Northern American States and of Canada, but of the greater part of the continent of North America, and in still larger proportion, of South America, nothing!

Under these circumstances, it follows that even with reference to that kind of imperfect information which we can possess, it is only of about the ten-thousandth part of the accessible parts of the earth that has been examined properly. Therefore, it is with justice that the most thoughtful of those who are concerned in these inquiries insist continually upon the imperfection of the geological record; for, I repeat, it is absolutely necessary, from the nature of things, that that record should be of the most fragmentary and imperfect character. Unfortunately this circumstance has been constantly forgotten. Men of science, like young colts in a fresh pasture, are apt to be exhilarated on being turned into a new field of inquiry, to go off at a hand-gallop, in total disregard of hedges and ditches, to lose sight of [342] the real limitation of their inquiries, and to forget the extreme imperfection of what is really known. Geologists have imagined that they could tell us what was going on at all parts of the earth's surface during a given epoch; they have talked of this deposit being contemporaneous with that deposit, until, from our little local histories of the changes at limited spots of the earth's surface, they have constructed a universal history of the globe as full of wonders and portents as any other story of antiquity.

But what does this attempt to construct a universal history of the globe imply? It implies that we shall not only have a precise knowledge of the events which have occurred at any particular point, but that we shall be able to say what events, at any one spot, took place at the same time with those at other spots.

Let us see how far that is in the nature of things practicable. Suppose that here I make a section of the Lake of Killarney, and here the section of another lake–that of Loch Lomond in Scotland for instance. The rivers that flow into them are constantly carrying down deposits of mud, and beds, or strata, are being as constantly formed, one above the other, at the bottom of those lakes. Now, there is not a shadow of doubt that in these two lakes the lower beds are all older than the upper–there is no doubt about that; but what does *this* tell us about the age of [343] any given bed in Loch Lomond, as compared with that of any given bed in the Lake of Killarney? It is, indeed, obvious that if any two sets of deposits are separated and discontinuous, there is absolutely no means whatever given you by the nature of the deposit of saying whether one is much younger or older than the other; but you may say, as many have said and think, that the case is very much altered if the beds which we are comparing are continuous. Suppose two beds of mud hardened into rock,–A and B–are seen in section. (Fig. 5.)

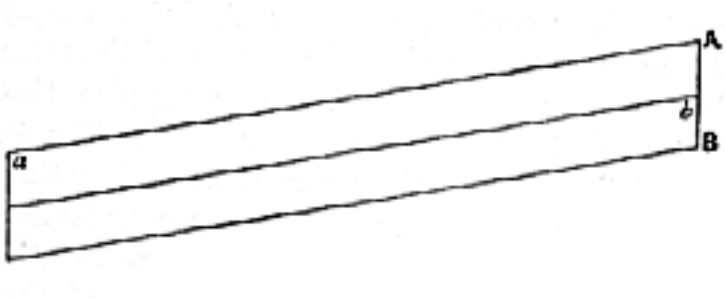


Fig. 5.

Well, you say, it is admitted that the lower-most bed is always the older. Very well; B, therefore, is older than A. No doubt, *as a whole,* it is so; or if any parts of the two beds which are in the same vertical line are compared, it is so. But suppose you take what seems a very natural step further, and say that the part

a of the bed A is younger than the part *b* of the bed B. Is this sound reasoning? If you find any record of changes taking place at *b*, did they occur before [344] any events which took place while *a* was being deposited? It looks all very plain sailing, indeed, to say that they did; and yet there is no proof of anything of the kind. As the former Director of this Institution, Sir H. De la Beche, long ago showed, this reasoning may involve an entire fallacy. It is extremely possible that *a* may have been deposited ages before *b*. It is very easy to understand how that can be. To return to Fig. 4; when A and B were deposited, they were *substantially* contemporaneous; A being simply the finer deposit, and B the coarser of the same detritus or waste of land. Now suppose that that sea-bottom goes down (as shown in Fig. 4), so that the first deposit is carried no farther than *a*, forming the bed A^1, and the coarse no farther than *b*, forming the bed B^1, the result will be the formation of two continuous beds, one of fine sediment (A A^1) over-lapping another of coarse sediment (B B^1). Now suppose the whole sea-bottom is raised up, and a section exposed about the point A^1; no doubt, *at this spot*, the upper bed is younger than the lower. But we should obviously greatly err if we concluded that the mass of the upper bed at A was younger than the lower bed at B; for we have just seen that they are contemporaneous deposits. Still more should we be in error if we supposed the upper bed at A to be younger than the continuation of the lower bed at B^1; for A was deposited long before B^1. [345] In fine, if, instead of comparing immediately adjacent parts of two beds, one of which lies upon another, we compare distant parts, it is quite possible that the upper may be any number of years older than the under, and the under any number of years younger than the upper.

Now you must not suppose that I put this before you for the purpose of raising a paradoxical difficulty; the fact is, that the great mass of deposits have taken place in sea-bottoms which are gradually sinking, and have been formed under the very conditions I am here supposing.

Do not run away with the notion that this subverts the principle I laid down at first. The error lies in extending a principle which is perfectly applicable to deposits in the same vertical line to deposits which are not in that relation to one another.

It is in consequence of circumstances of this kind, and of others that I might mention to you, that our conclusions on and interpretations of the record are really and strictly only valid so long as we confine ourselves to one vertical section. I do not mean to tell you that there are no qualifying circumstances, so that, even in very considerable areas, we may safely speak of conformably superimposed beds being older or younger than others at many different points. But we can never be quite sure in coming to that conclusion, and especially we cannot he sure if there is any break [346] in their continuity, or any very great distance between the points to be compared.

Well now, so much for the record itself,–so much for its imperfections,–so much for the conditions to be observed in interpreting it, and its chronological indications, the moment we pass beyond the limits of a vertical linear section.

Now let us pass from the record to that which it contains,–from the book itself to the writing and the figures on its pages. This writing and these figures consist of remains of animals and plants which, in the

great majority of cases, have lived and died in the very spot in which we now find them, or at least in the immediate vicinity. You must all of you be aware–and I referred to the fact in my last lecture–that there are vast numbers of creatures living at the bottom of the sea. These creatures, like all others, sooner or later die, and their shells and hard parts lie at the bottom; and then the fine mud which is being constantly brought down by rivers and the action of the wear and tear of the sea, covers them over and protects them from any further change or alteration; and, of course, as in process of time the mud becomes hardened and solidified, the shells of these animals are preserved and firmly imbedded in the limestone or sandstone which is being thus formed. You may see in the galleries of the Museum up stairs specimens of limestones in which such fossil remains of existing [347] animals are imbedded. There are some specimens in which turtles' eggs have been imbedded in calcareous sand, and before the sun had hatched the young turtles, they became covered over with calcareous mud, and thus have been preserved and fossilised.

Not only does this process of imbedding and fossilisation occur with marine and other aquatic animals and plants, but it affects those land animals and plants which are drifted away to sea, or become buried in bogs or morasses; and the animals which have been trodden down by their fellows and crushed in the mud at the river's bank, as the herd have come to drink. In any of these cases, the organisms may be crushed or be mutilated, before or after putrefaction, in such a manner that perhaps only a part will be left in the form in which it reaches us. It is, indeed, a most remarkable fact, that it is quite an exceptional case to find a skeleton of any one of all the thousands of wild land animals that we know are constantly being killed, or dying in the course of nature: they are preyed on and devoured by other animals, or die in places where their bodies are not afterwards protected by mud. There are other animals existing on the sea, the shells of which form exceedingly large deposits. You are probably aware that before the attempt was made to lay the Atlantic telegraphic cable, the Government employed vessels in making a series of very [348] careful observations and soundings of the bottom of the Atlantic; and although, as we must all regret, that up to the present time that project has not succeeded, we have the satisfaction of knowing that it yielded some most remarkable results to science. The Atlantic Ocean had to be sounded right across, to depths of several miles in some places, and the nature of its bottom was carefully ascertained. Well, now, a space of about 1,000 miles wide from east to west, and I do not exactly know how many from north to south, but at any rate 600 or 700 miles, was carefully examined, and it was found that over the whole of that immense area an excessively fine chalky mud is being deposited; and this deposit is entirely made up of animals whose hard parts are deposited in this part of the ocean, and are doubtless gradually acquiring solidity and becoming metamorphosed into a chalky limestone. Thus, you see, it is quite possible in this way to preserve unmistakable records of animal and vegetable life. Whenever the sea-bottom, by some of those undulations of the earth's crust that I have referred to, becomes up-heaved, and sections or borings are made, or pits are dug, then we become able to examine the contents and constituents of these ancient sea-bottoms, and find out what manner of animals lived at that period.

Now it is a very important consideration in its bearing on the completeness of the record, to [349] inquire how far the remains contained in these fossiliferous limestones are able to convey anything like an accurate or complete account of the animals which were in existence at the time of its formation. Upon that point we can form a very clear judgment, and one in which there is no possible room for any mistake. There are of course a great number of animals–such as jellyfishes, and other animals–without

any hard parts, of which we cannot reasonably expect to find any traces whatever: there is nothing of them to preserve. Within a very short time, you will have noticed, after they are removed from the water, they dry up to a mere nothing; certainly they are not of a nature to leave any very visible traces of their existence on such bodies as chalk or mud. Then again, look at land animals; it is, as I have said, a very uncommon thing to find a land animal entire after death. Insects and other carnivorous animals very speedily pull them to pieces, putrefaction takes place, and so, out of the hundreds of thousands that are known to die every year, it is the rarest thing in the world to see one imbedded in such a way that its remains would be preserved for a lengthened period. Not only is this the case, but even when animal remains have been safely imbedded, certain natural agents may wholly destroy and remove them.

Almost all the hard parts of animals–the bones and so on–are composed chiefly of phosphate [350] of lime and carbonate of lime. Some years ago, I had to make an inquiry into the nature of some very curious fossils sent to me from the North of Scotland. Fossils are usually hard bony structures that have become imbedded in the way I have described, and have gradually acquired the nature and solidity of the body with which they are associated; but in this case I had a series of *holes* in some pieces of rock, and nothing else. Those holes, however, had a certain definite shape about them, and when I got a skilful workman to make castings of the interior of these holes, I found that they were the impressions of the joints of a backbone and of the armour of a great reptile, twelve or more feet long. This great beast had died and got buried in the sand; the sand had gradually hardened over the bones, but remained porous. Water had trickled through it, and that water being probably charged with a superfluity of carbonic acid, had dissolved all the phosphate and carbonate of lime, and the bones themselves had thus decayed and entirely disappeared; but as the sandstone happened to have consolidated by that time, the precise shape of the bones was retained. If that sandstone had remained soft a little longer, we should have known nothing whatsoever of the existence of the reptile whose bones it had encased.

How certain it is that a vast number of animals which have existed at one period on this earth [351] have entirely perished, and left no trace whatever of their forms, may be proved to you by other considerations. There are large tracts of sandstone in various parts of the world, in which nobody has yet found anything but footsteps. Not a bone of any description, but an enormous number of traces of footsteps. There is no question about them. There is a whole valley in Connecticut covered with these footsteps, and not a single fragment of the animals which made them have yet been found. Let me mention another case while upon that matter, which is even more surprising than those to which I have yet referred. There is a limestone formation near Oxford, at a place called Stonesfield, which has yielded the remains of certain very interesting mammalian animals, and up to this time, if I recollect rightly, there have been found seven specimens of its lower jaws, and not a bit of anything else, neither limb-bones nor skull, nor any part whatever; not a fragment of the whole system! Of course, it would be preposterous to imagine that the beasts had nothing else but a lower jaw! The probability is, as Dr. Buckland showed, as the result of his observations on dead dogs in the river Thames, that the lower jaw, not being secured by very firm ligaments to the bones of the head, and being a weighty affair, would easily be knocked off, or might drop away from the body as it floated in water in a state of de[352] composition. The jaw would thus be deposited immediately, while the rest of the body would float and drift away altogether, ultimately reaching the sea, and perhaps becoming destroyed. The jaw becomes covered up and preserved in the river silt, and thus it comes that we have such a curious circumstance as

that of the lower jaws in the Stonesfield slates. So that, you see, faulty as these layers of stone in the earth's crust are, defective as they necessarily are as a record, the account of contemporaneous vital phenomena presented by them is, by the necessity of the case, infinitely more defective and fragmentary.

It was necessary that I should put all this very strongly before you, because, otherwise, you might have been led to think differently of the completeness of our knowledge by the next facts I shall state to you.

The researches of the last three-quarters of a century have, in truth, revealed a wonderful richness of organic life in those rocks. Certainly not fewer than thirty or forty thousand different species of fossils have been discovered. You have no more ground for doubting that these creatures really lived and died at or near the places in which we find them than you have for like scepticism about a shell on the sea-shore. The evidence is as good in the one case as in the other.

Our next business is to look at the general character of these fossil remains, and it is a subject [353] which will be requisite to consider carefully; and the first point for us is to examine how much the extinct *Flora* and *Fauna* as a *whole*–disregarding altogether the *succession* of their constituents, of which I shall speak afterwards–differ from the *Flora* and *Fauna* of the present day;–how far they differ in what we *do* know about them, leaving altogether out of consideration speculations based upon what we *do not* know.

I strongly imagine that if it were not for the peculiar appearance that fossilised animals have, any of you might readily walk through a museum which contains fossil remains mixed up with those of the present forms of life, and I doubt very much whether your uninstructed eyes would lead you to see any vast or wonderful difference between the two. If you looked closely, you would notice, in the first place, a great many things very like animals with which you are acquainted now: you would see differences of shape and proportion, but on the whole a close similarity.

I explained what I meant by Orders the other day, when I described the animal kingdom as being divided into sub-kingdoms, classes and orders. If you divide the animal kingdom into orders you will find that there are above one hundred and twenty. The number may vary on one side or the other, but this is a fair estimate. That is the sum total of the orders of all the animals which we know now, and which have [354] been known in past times, and left remains behind.

Now, how many of those are absolutely extinct? That is to say, how many of these orders of animals have lived at a former period of the world's history but have at present no representatives? That is the sense in which I meant to use the word "extinct." I mean that those animals did live on this earth at one time, but have left no one of their kind with us at the present moment. So that estimating the number of extinct animals is a sort of way of comparing the past creation as a whole with the present as a whole. Among the mammalia and birds there are none extinct; but when we come to the reptiles there is a most wonderful thing: out of the eight orders, or thereabouts, which you can make among reptiles, one-half are extinct. These diagrams of the plesiosaurus, the ichthyosaurus, the pterodactyle, give you a notion of some of these extinct reptiles. And here is a cast of the pterodactyle and bones of the ichthyosaurus and

the plesiosaurus, just as fresh-looking as if it had been recently dug up in a churchyard. Thus, in the reptile class, there are no less than half of the orders which are absolutely extinct. If we turn to the *Amphibia,* there was one extinct order, the Labyrinthodonts, typified by the large salamander-like beast shown in this diagram.

No order of fishes is known to be extinct. [355] Every fish that we find in the strata–to which I have been referring–can be identified and placed in one of the orders which exist at the present day. There is not known to be a single ordinal form of insect extinct. There are only two orders extinct among the *Crustacea.* There is not known to be an extinct order of these creatures, the parasitic and other worms; but there are two, not to say three, absolutely extinct orders of this class, the *Echinodermata;* out of all the orders of the *Cœlenterata* and *Protozoa* only one, the Rugose Corals.

So that, you see, out of somewhere about 120 orders of animals, taking them altogether, you will not, at the outside estimate, find above ten or a dozen extinct. Summing up all the orders of animals which have left remains behind them, you will not find above ten or a dozen which cannot be arranged with those of the present day; that is to say, that the difference does not amount to much more than ten per cent.: and the proportlon of extinct orders of plants is still smaller. I think that that is a very astounding a most astonishing fact: seeing the enormous epochs of time which have elapsed during the constitution of the surface of the earth as it at present exists, it is, indeed, a most astounding thing that the proportion of extinct ordinal types should be so exceedingly small.

But now, there is another point of view in which [356] we must look at this past creation. Suppose that we were to sink a vertical pit through the floor beneath us, and that I could succeed in making a section right through in the direction of New Zealand, I should find in each of the different beds through which I passed the remains of animals which I should find in that stratum and not in the others. First, I should come upon beds of gravel or drift containing the bones of large animals, such as the elephant, rhinoceros, and cave tiger. Rather curious things to fall across in Piccadilly! If I should dig lower still, I should come upon a bed of what we call the London clay, and in this, as you will see in our galleries up stairs, are found remains of strange cattle, remains of turtles, palms, and large tropical fruits; with shell-fish such as you see the like of now only in tropical regions. If I went below that, I should come upon the chalk, and there I should find something altogether different, the remains of ichthyosauria and pterodactyles, and ammonites, and so forth.

I do not know what Mr. Godwin Austin would say comes next, but probably rocks containing more ammonites, and more ichthyosauria and plesiosauria, with a vast number of other things; and under that I should meet with yet older rocks containing numbers of strange shells and fishes; and in thus passing from the surface to the lowest depths of the earth's crust, the forms of [357] animal life and vegetable life which I should meet with in the successive beds would, looking at them broadly, be the more different the further that I went down. Or, in other words, inasmuch as we started with the clear principle, that in a series of naturally-disposed mud beds the lowest are the oldest, we should come to this result, that the further we go back in time the more difference exists between the animal and vegetable life of an epoch and that which now exists. That was the conclusion to which I wished to bring you at the end of this lecture.

[358] III

The Method By Which the Causes of the Present and Past Conditions of Organic Nature Are To Be Discovered.–The Origination of Living Beings.

In the two preceding lectures I have endeavoured to indicate to you the extent of the subject-matter of the inquiry upon which we are engaged; and having thus acquired some conception of the past and present phenomena of organic nature, I must now turn to that which constitutes the great problem which we have set before ourselves;–I mean, the question of what knowledge we have of the causes of these phenomena of organic nature, and how such knowledge is obtainable.

Here, on the threshold of the inquiry, an objection meets us. There are in the world a number of extremely worthy, well-meaning persons, whose judgments and opinions are entitled to the utmost respect on account of their sincerity, who are of opinion that vital [359] phenomena, and especially all questions relating to the origin of vital phenomena, are questions quite apart from the ordinary run of inquiry, and are, by their very nature, placed out of our reach. They say that all these phenomena originated miraculously, or in some way totally different from the ordinary course of nature, and that therefore they conceive it to be futile, not to say presumptuous, to attempt to inquire into them.

To such sincere and earnest persons, I would only say, that a question of this kind is not to be shelved upon theoretical or speculative grounds. You may remember the story of the Sophist who demonstrated to Diogenes in the most complete and satisfactory manner that he could not walk; that, in fact, all motion was an impossibility; and that Diogenes refuted him by simply getting up and walking round his tub. So, in the same way, the man of science replies to objections of this kind, by simply getting up and walking onward, and showing what science has done and is doing–by pointing to that immense mass of facts which have been ascertained as systematised under the forms of the great doctrines of morphology, of development, of distribution, and the like. He sees an enormous mass of facts and laws relating to organic beings, which stand on the same good sound foundation as every other natural law. With this mass of facts and laws before us, therefore, seeing that, as far as organic matters [360] have hitherto been accessible and studied, they have shown themselves capable of yielding to scientific investigation, we may accept this as proof that order and law reign there as well as in the rest of Nature. The man of science says nothing to objectors of this sort, but supposes that we can and shall walk to a knowledge of the origin of organic nature, in the same way that we have walked to a knowledge of the laws and principles of the inorganic world.

But there are objectors who say the same from ignorance and ill-will. To such I would reply that the objection comes ill from them, and that the real presumption, I may almost say the real blasphemy, in this matter, is in the attempt to limit that inquiry into the causes of phenomena, which is the source of all human blessings, and from which has sprung all human prosperity and progress; for, after all, we can accomplish comparatively little; the limited range of our own faculties bounds us on every side,–the field of our powers of observation is small enough, and he who endeavours to narrow the sphere of our

inquiries is only pursuing a course that is likely to produce the greatest harm to his fellowmen.

But now, assuming, as we all do, I hope, that these phenomena are properly accessible to inquiry and setting out upon our search into the causes of the phenomena of organic nature, or at any [361] rate, setting out to discover how much we at present know upon these abstruse matters, the question arises as to what is to be our course of proceeding, and what method we must lay down for our guidance. I reply to that question, that our method must be exactly the same as that which is pursued in any other scientific inquiry, the method of scientific investigation being the same for all orders of facts and phenomena whatsoever.

I must dwell a little on this point, for I wish you to leave this room with a very clear conviction that scientific investigation is not, as many people seem to suppose, some kind of modern black art. I say that you might easily gather this impression from the manner in which many persons speak of scientific inquiry, or talk about inductive and deductive philosophy, or the principles of the "Baconian philosophy." I do protest that, of the vast number of cants in this world, there are none, to my mind, so contemptible as the pseudoscientific cant which is talked about the "Baconian philosophy."

To hear people talk about the great Chancellor–and a very great man he certainly was,–you would think that it was he who had invented science, and that there was no such thing as sound reasoning before the time of Queen Elizabeth! Of course you say, that cannot possibly be true; you perceive, on a moment's reflection, that such an idea is absurdly wrong, [362] and yet, so firmly rooted is this sort of impression,–I cannot call it an idea, or conception,–the thing is too absurd to be entertained,–but so completely does it exist at the bottom of most men's minds, that this has been a matter of observation with me for many years past. There are many men who, though knowing absolutely nothing of the subject with which they may be dealing, wish, nevertheless, to damage the author of some view with which they think fit to disagree. What they do, then, is not to go and learn something about the subject, which one would naturally think the best way of fairly dealing with it; but they abuse the originator of the view they question, in a general manner, and wind up by saying that, "After all, you know, the principles and method of this author are totally opposed to the canons of the Baconian philosophy." Then everybody applauds, as a matter of course, and agrees that it must be so. But if you were to stop them all in the middle of their applause, you would probably find that neither the speaker nor his applauders could tell you how or in what way it was so; neither the one nor the other having the slightest idea of what they mean when they speak of the "Baconian philosophy."

You will understand, I hope, that I have not the slightest desire to join in the outcry against either the morals, the intellect, or the great genius of Lord Chancellor Bacon. He was undoubtedly [363] a very great man, let people say what they will of him; but notwithstanding all that he did for philosophy, it would be entirely wrong to suppose that the methods of modern scientific inquiry originated with him, or with his age; they originated with the first man, whoever he was; and indeed existed long before him, for many of the essential processes of reasoning are exerted by the higher order of brutes as completely and effectively as by ourselves. We see in many of the brute creation the exercise of one, at least, of the same powers of reasoning as that which we ourselves employ.

The method of scientific investigation is nothing but the expression of the necessary mode of working of the human mind. It is simply the mode at which all phenomena are reasoned about, rendered precise and exact. There is no more difference, but there is just the same kind of difference, between the mental operations of a man of science and those of an ordinary person, as there is between the operations and methods of a baker or of a butcher weighing out his goods in common scales, and the operations of a chemist in performing a difficult and complex analysis by means of his balance and finely-graduated weights. It is not that the action of the scales in the one case, and the balance in the other, differ in the principles of their construction or manner of working; but the beam of one is set on an infinitely finer axis than [364] the other, and of course turns by the addition of a much smaller weight.

You will understand this better, perhaps, if I give you some familiar example. You have all heard it repeated, I dare say, that men of science work by means of induction and deduction, and that by the help of these operations, they, in a sort of sense, wring from Nature certain other things, which are called natural laws, and causes, and that out of these, by some cunning skill of their own, they build up hypotheses and theories. And it is imagined by many, that the operations of the common mind can be by no means compared with these processes, and that they have to be acquired by a sort of special apprenticeship to the craft. To hear all these large words, you would think that the mind of a man of science must be constituted differently from that of his fellow men; but if you will not be frightened by terms, you will discover that you are quite wrong, and that all these terrible apparatus are being used by yourselves every day and every hour of your lives.

There is a well-known incident in one of Molière's plays, where the author makes the hero express unbounded delight on being told that he had been talking prose during the whole of his life. In the same way, I trust, that you will take comfort, and be delighted with yourselves, on the discovery that you have been acting on the prin[365]ciples of inductive and deductive philosophy during the same period. Probably there is not one here who has not in the course of the day had occasion to set in motion a complex train of reasoning, of the very same kind, though differing of course in degree, as that which a scientific man goes through in tracing the causes of natural phenomena.

A very trivial circumstance will serve to exemplify this. Suppose you go into a fruiterer's shop, wanting an apple,–you take up one, and, on biting it, you find it is sour; you look at it, and see that it is hard and green. You take up another one, and that too is hard, green, and sour. The shopman offers you a third; but, before biting it, you examine it, and find that it is hard and green, and you immediately say that you will not have it, as it must be sour, like those that you have already tried.

Nothing can be more simple than that, you think; but if you will take the trouble to analyze and trace out into its logical elements what has been done by the mind, you will be greatly surprised. In the first place, you have performed the operation of induction. You found that, in two experiences, hardness and greenness in apples went together with sourness. It was so in the first case, and it was confirmed by the second. True, it is a very small basis, but still it is enough [366] to make an induction from; you generalise the facts, and you expect to find sourness in apples where you get hardness and greenness. You found upon that a general law, that all hard and green apples are sour; and that, so far as it goes, is a

perfect induction. Well, having got your natural law in this way, when you are offered another apple which you find is hard and green, you say, "All hard and green apples are sour; this apple is hard and green, therefore this apple is sour." That train of reasoning is what logicians call a syllogism, and has all its various parts and terms,–its major premiss, its minor premiss, and its conclusion. And, by the help of further reasoning, which, if drawn out, would have to be exhibited in two or three other syllogisms, you arrive at your final determination, "I will not have that apple." So that, you see, you have, in the first place, established a law by induction, and upon that you have founded a deduction, and reasoned out the special conclusion of the particular case. Well now, suppose, having got your law, that at some time afterwards, you are discussing the qualities of apples with a friend: you will say to him, "It is a very curious thing,–but I find that all hard and green apples are sour!" Your friend says to you, "But how do you know that?" You at once reply, "Oh, because I have tried them over and over again, and have always found them to be so." Well. if we were talking science instead of common [367] sense, we should call that an experimental verification. And, if still opposed, you go further, and say, "I have heard from the people in Somersetshire and Devonshire, where a large number of apples are grown, that they have observed the same thing. It is also found to be the case in Normandy, and in North America. In short, I find it to be the universal experience of mankind wherever attention has been directed to the subject." Whereupon, your friend, unless he is a very unreasonable man, agrees with you, and is convinced that you are quite right in the conclusion you have drawn. He believes, although perhaps he does not know he believes it, that the more extensive verifications are,–that the more frequently experiments have been made, and results of the same kind arrived at,–that the more varied the conditions under which the same results are attained, the more certain is the ultimate conclusion, and he disputes the question no further. He sees that the experiment has been tried under all sorts of conditions, as to time, place, and people, with the same result; and he says with you, therefore, that the law you have laid down must be a good one, and he must believe it.

In science we do the same thing;–the philosopher exercises precisely the same faculties, though in a much more delicate manner. In scientific inquiry it becomes a matter of duty to expose a supposed law to every possible kind of [368] verification, and to take care, moreover, that this is done intentionally, and not left to a mere accident, as in the case of the apples. And in science, as in common life, our confidence in a law is in exact proportion to the absence of variation in the result of our experimental verifications. For instance, if you let go your grasp of an article you may have in your hand, it will immediately fall to the ground. That is a very common verification of one of the best established laws of nature–that of gravitation. The method by which men of science establish the existence of that law is exactly the same as that by which we have established the trivial proposition about the sourness of hard and green apples. But we believe it in such an extensive, thorough, and unhesitating manner because the universal experience of mankind verifies it, and we can verify it ourselves at any time; and that is the strongest possible foundation on which any natural law can rest.

So much, then, by way of proof that the method of establishing laws in science is exactly the same as that pursued in common life. Let us now turn to another matter (though really it is but another phase of the same question), and that is, the method by which, from the relations of certain phenomena, we prove that some stand in the position of causes towards the others.

I want to put the case clearly before you, and I will therefore show you what I mean by another [369] familiar example. I will suppose that one of you, on coming down in the morning to the parlour of your house, finds that a tea-pot and some spoons which had been left in the room on the previous evening are gone,–the window is open, and you observe the mark of a dirty hand on the window-frame, and perhaps, in addition to that, you notice the impress of a hob-nailed shoe on the gravel outside. All these phenomena have struck your attention instantly, and before two seconds have passed you say, "Oh, somebody has broken open the window, entered the room, and run off with the spoons and the tea-pot!" That speech is out of your mouth in a moment. And you will probably add, "I know there has; I am quite sure of it!" You mean to say exactly what you know; but in reality you are giving expression to what is, in all essential particulars, an hypothesis. You do not *know* it at all; it is nothing but all hypothesis rapidly framed in your own mind. And it is an hypothesis founded on a long train of inductions and deductions.

What are those inductions and deductions, and how have you got at this hypothesis? You have observed, in the first place, that the window is open; but by a train of reasoning involving many inductions and deductions, you have probably arrived long before at the general law–and a very good one it is–that windows do not open of themselves; and you therefore conclude that [370] something has opened the window. A second general law that you have arrived at in the same way is, that tea-pots and spoons do not go out of a window spontaneously, and you are satisfied that, as they are not now where you left them, they have been removed. In the third place, you look at the marks on the window-sill, and the shoemarks outside, and you say that in all previous experience the former kind of mark has never been produced by anything else but the hand of a human being; and the same experience shows that no other animal but man at present wears shoes with hob-nails in them such as would produce the marks in the gravel. I do not know, even if we could discover any of those "missing links" that are talked about, that they would help us to any other conclusion! At any rate the law which states our present experience is strong enough for my present purpose. You next reach the conclusion, that as these kinds of marks have not been left by any other animals than men, or are liable to be formed in any other way than by a man's hand and shoe, the marks in question have been formed by a man in that way. You have, further, a general law, founded on observation and experience, and that, too, is, I am sorry to say, a very universal and unimpeachable one,–that some men are thieves; and you assume at once from all these premisses–and that is what constitutes your hypothesis–that the man who made the marks [371] outside and on the window-sill, opened the window, got into the room, and stole your tea-pot and spoons. You have now arrived at a *vera causa;*–you have assumed a cause which, it is plain, is competent to produce all the phenomena you have observed. You can explain all these phenomena only by the hypothesis of a thief. But that is a hypothetical conclusion, of the justice of which you have no absolute proof at all; it is only rendered highly probable by a series of inductive and deductive reasonings.

I suppose your first action, assuming that you are a man of ordinary common sense, and that you have established this hypothesis to your own satisfaction, will very likely be to go off for the police, and set them on the track of the burglar, with the view to the recovery of your property. But just as you are starting with this object, some person comes in, and on learning what you are about, says, "My good friend, you are going on a great deal too fast. How do you know that the man who really made the marks took the spoons? It might have been a monkey that took them, and the man may have merely looked in

afterwards." You would probably reply, "Well, that is all very well, but you see it is contrary to all experience of the way tea-pots and spoons are abstracted; so that, at any rate, your hypothesis is less probable than mine." While you are talking the thing over in this way, another friend arrives, one of [372] that good kind of people that I was talking of a little while ago. And he might say, "Oh, my dear sir, you are certainly going on a great deal too fast. You are most presumptuous. You admit that all these occurrences took place when you were fast asleep, at a time when you could not possibly have known anything about what was taking place. How do you know that the laws of Nature are not suspended during the night? It may be that there has been some kind of supernatural interference in this case." In point of fact, he declares that your hypothesis is one of which you cannot at all demonstrate the truth, and that you are by no means sure that the laws of Nature are the same when you are asleep as when you are awake.

Well, now, you cannot at the moment answer that kind of reasoning. You feel that your worthy friend has you somewhat at a disadvantage. You will feel perfectly convinced in your own mind, however, that you are quite right, and you say to him, "My good friend, I can only be guided by the natural probabilities of the case, and if you will be kind enough to stand aside and permit me to pass, I will go and fetch the police." Well, we will suppose that your journey is successful, and that by good luck you meet with a policeman; that eventually the burglar is found with your property on his person, and the marks correspond to his hand and to his boots. Probably any jury [373] would consider those facts a very good experimental verification of your hypothesis, touching the cause of the abnormal phenomena observed in your parlour, and would act accordingly.

Now, in this suppositious case, I have taken phenomena of a very common kind, in order that you might see what are the different steps in an ordinary process of reasoning, if you will only take the trouble to analyse it carefully. All the operations I have described, you will see, are involved in the mind of any man of sense in leading him to a conclusion as to the course he should take in order to make good a robbery and punish the offender. I say that you are led, in that case, to your conclusion by exactly the same train of reasoning as that which a man of science pursues when he is endeavouring to discover the origin and laws of the most occult phenomena. The process is, and always must be, the same; and precisely the same mode of reasoning was employed by Newton and Laplace in their endeavours to discover and define the causes of the movements of the heavenly bodies, as you, with your own common sense, would employ to detect a burglar. The only difference is, that the nature of the inquiry being more abstruse, every step has to be most carefully watched, so that there may not be a single crack or flaw in your hypothesis. A flaw or crack in many of the hypotheses of [374] daily life may be of little or no moment as affecting the general correctness of the conclusions at which we may arrive; but, in a scientific inquiry, a fallacy, great or small, is always of importance, and is sure to be in the long run constantly productive of mischievous, if not fatal results.

Do not allow yourselves to be misled by the common notion that an hypothesis is untrustworthy simply because it is an hypothesis. It is often urged, in respect to some scientific conclusion, that, after all, it is only an hypothesis. But what more have we to guide us in nine-tenths of the most important affairs of daily life than hypotheses, and often very ill-based ones? So that in science, where the evidence of an hypothesis is subjected to the most rigid examination, we may rightly pursue the same course. You may

have hypotheses and hypotheses. A man may say, if he likes, that the moon is made of green cheese: that is an hypothesis. But another man, who has devoted a great deal of time and attention to the subject, and availed himself of the most powerful telescopes and the results of the observations of others, declares that in his opinion it is probably composed of materials very similar to those of which our own earth is made up: and that is also only an hypothesis. But I need not tell you that there is an enormous difference in the value of the [375] two hypotheses. That one which is based on sound scientific knowledge is sure to have a corresponding value; and that which is a mere hasty random guess is likely to have but little value. Every great step in our progress in discovering causes has been made in exactly the same way as that which I have detailed to you. A person observing the occurrence of certain facts and phenomena asks, naturally enough, what process, what kind of operation known to occur in Nature applied to the particular case, will unravel and explain the mystery? Hence you have the scientific hypothesis; and its value will be proportionate to the care and completeness with which its basis had been tested and verified. It is in these matters as in the commonest affairs of practical life: the guess of the fool will be folly, while the guess of the wise man will contain wisdom. In all cases, you see that the value of the result depends on the patience and faithfulness with which the investigator applies to his hypothesis every possible kind of verification.

I dare say I may have to return to this point by and by; but having dealt thus far with our logical methods, I must now turn to something which, perhaps, you may consider more interesting, or, at any rate, more tangible. But in reality there are but few things that can be more important for you to understand than the mental processes and the means by which we obtain scientific [376] conclusions and theories.[1] Having granted that the inquiry is a proper one, and having determined on the nature of the methods we are to pursue and which only can lead to success, I must now turn to the consideration of our knowledge of the nature of the processes which have resulted in the present condition of organic nature.

Here, let me say at once, lest some of you misunderstand me, that I have extremely little to report. The question of how the present condition of organic nature came about, resolves itself into two questions. The first is: How has organic or living matter commenced its existence? And the second is: How has it been perpetuated? On the second question I shall have more to say hereafter. But on the first one, what I now have to say will be for the most part of a negative character.

If you consider what kind of evidence we can have upon this matter, it will resolve itself into two kinds. We may have historical evidence and we may have experimental evidence. It is, for example, conceivable, that inasmuch as the hardened mud which forms a considerable portion of the thickness of the earth's crust contains faithful records of the past forms of life, and inasmuch as these differ more and more as we go further down,–it is possible and conceivable that we might come to [377] some particular bed or stratum which should contain the remains of those creatures with which organic life began upon the earth. And if we did so, and if such forms of organic life were preservable, we should have what I would call historical evidence of the mode in which organic life began upon this planet. Many persons will tell you, and indeed you will find it stated in many works on geology, that this has been done, and that we really possess such a record; there are some who imagine that the earliest forms of life of which

we have as yet discovered any record, are in truth the forms in which animal life began upon the globe. The grounds on which they base that supposition are these:–That if you go through the enormous thickness of the earth's crust and get down to the older rocks, the higher vertebrate animals–the quadrupeds, birds, and fishes–cease to be found; beneath them you find only the invertebrate animals; and in the deepest and lowest rocks those remains become scantier and scantier, not in any very gradual progression, however, until, at length, in what are supposed to be the oldest rocks, the animal remains which are found are almost always confined to four forms–*Oldhamia*, whose precise nature is not known, whether plant or animal; *Lingula*, a kind of mollusc; *Trilobites*, a crustacean animal, having the same essential plan of construction, though differing in many details from a lobster or crab; and *Hymenocaris*, [378] which is also a crustacean. So that you have all the *Fauna* reduced, at this period, to four forms: one a kind of animal or plant that we know nothing about, and three undoubted animals–two crustaceans and one mollusc.

I think, considering the organisation of these mollusca and crustacea, and looking at their very complex nature, that it does indeed require a very strong imagination to conceive that these were the first created of all living things. And you must take into consideration the fact that we have not the slightest proof that these which we call the oldest beds are really so: I repeat, we have not the slightest proof of it. When you find in some places that in an enormous thickness of rocks there are but very scanty traces of life, or absolutely none at all; and that in other parts of the world rocks of the very same formation are crowded with the records of living forms, I think it is impossible to place any reliance on the supposition, or to feel one's self justified in supposing that these are the forms in which life first commenced. I have not time here to enter upon the technical grounds upon which I am led to this conclusion,–that could hardly be done properly in half a dozen lectures on that part alone–I must content myself with saying that I do not at all believe that these are the oldest forms of life.

I turn to the experimental side to see what [379] evidence we have there. To enable us to say that we know anything about the experimental origination of organisation and life, the investigator ought to be able to take inorganic matters, such as carbonic acid, ammonia, water, and salines, in any sort of inorganic combination, and be able to build them up into protein matter, and then that protein matter ought to begin to live in an organic form. That, nobody has done as yet, and I suspect it will be a long while before anybody does do it. But the thing is by no means so impossible as it looks; for the researches of modern chemistry have shown us–I won't say the road towards it, but, if I may so say, they have shown the finger-post pointing to the road that may lead to it.

It is not many years ago–and you must recollect that Organic Chemistry is a young science, not above a couple of generations old, you must not expect too much of it,–it is not many years ago since it was said to be perfectly impossible to fabricate any organic compound; that is to say, any non-mineral compound which is to be found in an organised being. It remained so for a very long period; but it is now a considerable number of years since a distinguished foreign chemist contrived to fabricate urea, a substance of a very complex character, which forms one of the waste products of animal structures. And of late years a number of other compounds, such as butyric [380] acid, and others, have been added to the list. I need not tell you that chemistry is an enormous distance from the goal I indicate; all I wish to point out to you is, that it is by no means safe to say that that goal may not be reached one day. It may be

that it is impossible for us to produce the conditions requisite to the origination of life; but we must speak modestly about the matter, and recollect that Science has put her foot upon the bottom round of the ladder. Truly he would be a bold man who would venture to predict where she will be fifty years hence.

There is another inquiry which bears indirectly upon this question, and upon which I must say a few words. You are all of you aware of the phenomena of what is called spontaneous generation. Our forefathers, down to the seventeenth century, or thereabouts, all imagined, in perfectly good faith, that certain vegetable and animal forms gave birth, in the process of their decomposition, to insect life. Thus, if you put a piece of meat in the sun, and allowed it to putrefy, they conceived that the grubs which soon began to appear were the result of the action of a power of spontaneous generation which the meat contained. And they could give you receipts for making various animal and vegetable preparations which would produce particular kinds of animals. A very distinguished Italian naturalist, named Redi, took up the question, at a time when everybody [381] believed in it; among others our own great Harvey, the discoverer of the circulation of the blood. You will constantly find his name quoted, however, as an opponent of the doctrine of spontaneous generation; but the fact is, and you will see it if you will take the trouble to look into his works, Harvey believed it as profoundly as any man of his time; but he happened to enunciate a very curious proposition–that every living thing came from an egg; he did not mean to use the word in the sense in which we now employ it, he only meant to say that every living thing originated in a little rounded particle of organised substance; and it is from this circumstance, probably, that the notion of Harvey having opposed the doctrine originated. Then came Redi, and he proceeded to upset the doctrine in a very simple manner. He merely covered the piece of meat with some very fine gauze, and then he exposed it to the same conditions. The result of this was that no grubs or insects were produced; he proved that the grubs originated from the insects who came and deposited their eggs in the meat, and that they were hatched by the heat of the sun. By this kind of inquiry he thoroughly upset the doctrine of spontaneous generation, for his time at least.

Then came the discovery and application of the microscope to scientific inquiries, which showed to naturalists that besides the organisms which they [382] already knew as living beings and plants, there were an immense number of minute things which could be obtained apparently almost at will from decaying vegetable and animal forms. Thus, if you took some ordinary black pepper or some hay, and steeped it in water, you would find in the course of a few days that the water had become impregnated with an immense number of animalcules swimming about in all directions. From facts of this kind naturalists were led to revive the theory of spontaneous generation. They were headed here by an English naturalist,–Needham,–and afterwards in France by the learned Buffon. They said that these things were absolutely begotten in the water of the decaying substances out of which the infusion was made. It did not matter whether you took animal or vegetable matter, you had only to steep it in water and expose it, and you would soon have plenty of animalcules. They made an hypothesis about this which was a very fair one. They said, this matter of the animal world, or of the higher plants, appears to be dead, but in reality it has a sort of dim life about it, which, if it is placed under fair conditions, will cause it to break up into the forms of these little animalcules, and they will go through their lives in the same way as the animal or plant of which they once formed a part.

The question now became very hotly debated. Spallanzani, an Italian naturalist, took up opposite [383] views to those of Needham and Buffon, and by means of certain experiments he showed that it was quite possible to stop the process by boiling the water, and closing the vessel in which it was contained. "Oh!" said his opponents; "but what do you know you may be doing when you heat the air over the water in this way? You may be destroying some property of the air requisite for the spontaneous generation of the animalcules."

However, Spallanzani's views were supposed to be upon the right side, and those of the others fell into discredit; although the fact was that Spallanzani had not made good his views. Well, then, the subject continued to be revived from time to time, and experiments were made by several persons; but these experiments were not altogether satisfactory. It was found that if you put an infusion in which animalcules would appear if it were exposed to the air into a vessel and boiled it, and then sealed up the mouth of the vessel, so that no air, save such as had been heated to 212°, could reach its contents, that then no animalcules would be found; but if you took the same vessel and exposed the infusion to the air, then you would get animalcules. Furthermore, it was found that if you connected the mouth of the vessel with a red-hot tube in such a way that the air would have to pass through the tube before reaching the infusion, that then you would get no animalcules. Yet another thing was noticed: if you took two flasks [384] containing the same kind of infusion, and left one entirely exposed to the air, and in the mouth of the other placed a ball of cotton wool, so that the air would have to filter itself through it before reaching the infusion, that then, although you might have plenty of animalcules in the first flask, you would certainly obtain none from the second.

These experiments, you see, all tended towards one conclusion–that the infusoria were developed from little minute spores or eggs which were constantly floating in the atmosphere, and which lose their power of germination if subjected to heat. But one observer now made another experiment which seemed to go entirely the other way, and puzzled him altogether. He took some of this boiled infusion that I have been speaking of, and by the use of a mercurial bath–a kind of trough used in laboratories–he deftly inverted a vessel containing the infusion into the mercury, so that the latter reached a little beyond the level of the mouth of the *inverted* vessel. You see that he thus had a quantity of the infusion shut off from any possible communication with the outer air by being inverted upon a bed of mercury.

He then prepared some pure oxygen and nitrogen gases, and passed them by means of a tube going from the outside of the vessel, up through the mercury into the infusion; so that he thus had it exposed to a perfectly pure atmosphere of the same constituents as the external air. Of [385] course, he expected he would get no infusorial animalcules at all in that infusion; but, to his great dismay and discomfiture, he found he almost always did get them.

Furthermore, it has been found that experiments made in the manner described above answer well with most infusions; but that if you fill the vessel with boiled milk, and then stop the neck with cotton-wool, you *will* have infusoria. So that you see there were two experiments that brought you to one kind of conclusion, and three to another; which was a most unsatisfactory state of things to arrive at in a scientific inquiry.

Some few years after this, the question began to be very hotly discussed in France. There was M. Pouchet, a professor at Rouen, a very learned man, but certainly not a very rigid experimentalist. He published a number of experiments of his own, some of which were very ingenious, to show that if you went to work in a proper way, there was a truth in the doctrine of spontaneous generation. Well, it was one of the most fortunate things in the world that M. Pouchet took up this question, because it induced a distinguished French chemist, M. Pasteur, to take up the question on the other side; and he has certainly worked it out in the most perfect manner. I am glad to say, too, that he has published his researches in time to enable me to give you an account of them. He verified all the experiments which I have just mentioned [386] to you–and then finding those extraordinary anomalies, as in the case of the mercury bath and the milk, he set himself to work to discover their nature. In the case of milk he found it to be a question of temperature. Milk in a fresh state is slightly alkaline; and it is a very curious circumstance, but this very slight degree of alkalinity seems to have the effect of preserving the organisms which fall into it from the air from being destroyed at a temperature of 212°, which is the boiling point. But if you raise the temperature 10° when you boil it, the milk behaves like everything else; and if the air with which it comes in contact, after being boiled at this temperature, is passed through a red-hot tube, you will not get a trace of organisms.

He then turned his attention to the mercury bath, and found on examination that the surface of the mercury was almost always covered with a very fine dust. He found that even the mercury itself was positively full of organic matters; that from being constantly exposed to the air, it had collected an immense number of these infusorial organisms from the air. Well, under these circumstances he felt that the case was quite clear, and that the mercury was not what it had appeared to M. Schwann to be,–a bar to the admission of these organisms; but that, in reality, it acted as a reservoir from which the infusion was immediately supplied with the large quantity that had so puzzled him.

[387] But not content with explaining the experiments of others, M. Pasteur went to work to satisfy himself completely. He said to himself: "If my view is right, and if, in point of fact, all these appearances of spontaneous generation are altogether due to the falling of minute germs suspended in the atmosphere,–why, I ought not only to be able to show the germs, but I ought to be able to catch and sow them, and produce the resulting organisms." He, accordingly, constructed a very ingenious apparatus to enable him to accomplish the trapping of the "*germ dust*" in the air. He fixed in the window of his room a glass tube, in the centre of which he had placed a ball of gun-cotton, which, as you all know, is ordinary cotton-wool, which, from having been steeped in strong acid, is converted into a substance of great explosive power. It is also soluble in alcohol and ether. One end of the glass tube was, of course, open to the external air; and at the other end of it he placed an aspirator, a contrivance for causing a current of the external air to pass through the tube. He kept this apparatus going for four-and-twenty hours, and then removed the *dusted* gun-cotton, and dissolved it in alcohol and ether. He then allowed this to stand for a few hours, and the result was, that a very fine dust was gradually deposited at the bottom of it. That dust, on being transferred to the stage of a microscope, was found to contain an enormous number of starch grains. [388] You know that the materials of our food and the greater portion of plants are composed of starch, and we are constantly making use of it in a variety of ways, so that there is always a quantity of it suspended in the air. It is these starch grains which form many of those bright specks that we see dancing in a ray of light sometimes. But besides these, M. Pasteur found also

an immense number of other organic substances such as spores of fungi, which had been floating about in the air and had got caged in this way.

He went farther, and said to himself, "If these really are the things that give rise to the appearance of spontaneous generation, I ought to be able to take a ball of this *dusted* gun-cotton and put it into one of my vessels, containing that boiled infusion which has been kept away from the air, and in which no infusoria are at present developed, and then, if I am right, the introduction of this gun-cotton will give rise to organisms."

Accordingly, he took one of these vessels of infusion, which had been kept eighteen months, without the least appearance of life in it, and by a most ingenious contrivance, he managed to break it open and introduce such a ball of gun-cotton, without allowing the infusion or the cotton ball to come into contact with any air but that which had been subjected to a red heat, and in twenty-four hours he had the satisfaction of finding all the indications of what had been hitherto called spon[389]taneous generation. He had succeeded in catching the germs and developing organisms in the way he had anticipated.

It now struck him that the truth of his conclusions might be demonstrated without all the apparatus he had employed. To do this, he took some decaying animal or vegetable substance, such as urine, which is an extremely decomposable substance, or the juice of yeast, or perhaps some other artificial preparation, and filled a vessel having a long tubular neck with it. He then boiled the liquid and bent that long neck into an S shape or zig-zag, leaving it open at the end. The infusion then gave no trace of any appearance of spontaneous generation, however long it might be left, as all the germs in the air were deposited in the beginning of the bent neck. He then cut the tube close to the vessel, and allowed the ordinary air to have free and direct access; and the result of that was the appearance of organisms in it, as soon as the infusion had been allowed to stand long enough to allow of the growth of those it received from the air, which was about forty-eight hours. The result of M. Pasteur's experiments proved, therefore, in the most conclusive manner, that all the appearances of spontaneous generation arose from nothing more than the deposition of the germs of organisms which were constantly floating in the air.

To this conclusion, however, the objection was made, that if that were the cause, then the air [390] would contain such an enormous number of these germs, that it would be a continual fog. But M. Pasteur replied that they are not there in anything like the number we might suppose, and that an exaggerated view has been held on that subject; he showed that the chances of animal or vegetable life appearing in infusions, depend entirely on the conditions under which they are exposed. If they are exposed to the ordinary atmosphere around us, why, of course, you may have organisms appearing early. But, on the other hand, if they are exposed to air at a great height, or in some very quiet cellar, you will often not find a single trace of life.

So that M. Pasteur arrived at last at the clear and definite result, that all these appearances are like the case of the worms in the piece of meat, which was refuted by Redi, simply germs carried by the air and deposited in the liquids in which they afterwards appear. For my own part, I conceive that, with the particulars of M. Pasteur's experiments before us, we cannot fail to arrive at his conclusions; and that the

doctrine of spontaneous generation has received a final *coup de grâce.*

You, of course, understand that all this in no way interferes with the *possibility* of the fabrication of organic matters by the direct method to which I have referred, remote as that possibility may be.

[391] IV

The Perpetuation of Living Beings, Hereditary Transmission and Variation

The inquiry which we undertook, at our last meeting, into the state of our knowledge of the causes of the phenomena of organic nature,–of the past and of the present,–resolved itself into two subsidiary inquiries: the first was, whether we know anything, either historically or experimentally, of the mode of origin of living beings; the second subsidiary inquiry was, whether, granting the origin, we know anything about the perpetuation and modifications of the forms of organic beings. The reply which I had to give to the first question was altogether negative, and the chief result of my last lecture was, that, neither historically nor experimentally, do we at present know anything whatsoever about the origin of living forms. We saw that, historically, we are not likely to know anything about it, although we may perhaps learn something experimentally; but that at present we are an enormous distance from the goal I indicated.

[392] I now, then, take up the next question, What do we know of the reproduction, the perpetuation, and the modifications of the forms of living beings, supposing that we have put the question as to their origination on one side, and have assumed that at present the causes of their origination are beyond us, and that we know nothing about them? Upon this question the state of our knowledge is extremely different; it is exceedingly large: and, if not complete, our experience is certainly most extensive. It would be impossible to lay it all before you, and the most I can do, or need do to-night, is to take up the principal points and put them before you with such prominence as may subserve the purposes of our present argument.

The method of the perpetuation of organic beings is of two kinds,–the non-sexual and the sexual. In the first the perpetuation takes place from and by a particular act of an individual organism, which sometimes may not be classed as belonging to any sex at all. In the second case, it is in consequence of the mutual action and interaction of certain portions of the organisms of usually two distinct individuals,–the male and the female. The cases of non-sexual perpetuation are by no means so common as the cases of sexual perpetuation; and they are by no means so common in the animal as in the vegetable world. You are all probably familiar with the fact, as a matter of experience, that you can propagate plants by means of what [393] are called "cuttings"; for example, that by taking a cutting from a geranium plant, and rearing it properly, by supplying it with light and warmth and nourishment from the earth, it grows up and takes the form of its parent, having all the properties and peculiarities of the original plant.

Sometimes this process, which the gardener performs artificially, takes place naturally; that is to say, a

little bulb, or portion of the plant, detaches itself, drops off, and becomes capable of growing as a separate thing. That is the case with many bulbous plants, which throw off in this way secondary bulbs, which are lodged in the ground and become developed into plants. This is a non-sexual process and from it results the repetition or reproduction of the form of the original being from which the bulb proceeds.

Among animals the same thing takes place. Among the lower forms of animal life, the infusorial animalculæ we have already spoken of throw off certain portions, or break themselves up in various directions, sometimes transversely or sometimes longitudinally; or they may give off buds, which detach themselves and develop into their proper forms. There is the common fresh-water polype, for instance, which multiplies itself in this way. Just in the same way as the gardener is able to multiply and reproduce the peculiarities and characters of particular plants by means of cuttings, so can the physiological experimentalist–as was [394] shown by the Abbé Trembley many years ago–so can he do the same thing with many of the lower forms of animal life. M. de Trembley showed that you could take a polype and cut it into two, or four, or many pieces, mutilating it in all directions, and the pieces would still grow up and reproduce completely the original form of the animal. These are all cases of non-sexual multiplication, and there are other instances, and still more extraordinary ones, in which this process takes place naturally, in a more hidden, a more recondite kind of way. You are all of you familiar with that little green insect, the *Aphis* or blight, as it is called. These little animals, during a very considerable part of their existence, multiply themselves by means of a kind of internal budding, the buds being developed into essentially non-sexual animals, which are neither male nor female; they become converted into young *Aphides*, which repeat the process, and their offspring after them, and so on again; you may go on for nine or ten, or even twenty or more successions; and there is no very good reason to say how soon it might terminate, or how long it might not go on if the proper conditions of warmth and nourishment were kept up.

Sexual reproduction is quite a distinct matter. Here, in all these cases, what is required is the detachment of two portions of the parental organisms, which portions we know as the egg or the spermatozoon. In plants it is the ovule [395] and the pollen-grain, as in the flowering plants, or the ovule and the antherozooid, as in the flowerless. Among all forms of animal life, the spermatozoa proceed from the male sex, and the egg is the product of the female. Now, what is remarkable about this mode of reproduction is this, that the egg by itself, or the spermatozoa by themselves, are unable to assume the parental form; but if they be brought into contact with one another, the effect of the mixture of organic substances proceeding from two sources appears to confer an altogether new vigour to the mixed product. This process is brought about, as we all know, by the sexual intercourse of the two sexes, and is called the act of impregnation. The result of this act on the part of the male and female is, that the formation of a new being is set up in the ovule or egg; this ovule or egg soon begins to be divided and subdivided, and to be fashioned into various complex organs, and eventually to develop into the form of one of its parents, as I explained in the first lecture. These are the processes by which the perpetuation of organic beings is secured. Why there should be the two modes–why this re-invigoration should be required on the part of the female element we do not know; but it is most assuredly the fact, and it is presumable, that, however long the process of non-sexual multiplication could be continued–I say there is good reason to believe that it would come to an end if a new [396] commencement were not obtained by a conjunction of the two sexual elements.

That character which is common to these two distinct processes is this, that, whether we consider the reproduction, or perpetuation, or modification of organic beings as they take place non-sexually, or as they may take place sexually–in either case, I say, the offspring has a constant tendency to assume, speaking generally, the character of the parent. As I said just now, if you take a slip of a plant, and tend it with care, it will eventually grow up and develop into a plant like that from which it had sprung; and this tendency is so strong that, as gardeners know, this mode of multiplying by means of cuttings is the only secure mode of propagating very many varieties of plants; the peculiarity of the primitive stock seems to be better preserved if you propagate it by means of a slip than if you resort to the sexual mode.

Again, in experiments upon the lower animals, such as the polype, to which I have referred, it is most extraordinary that, although cut up into various pieces, each particular piece will grow up into the form of the primitive stock; the head, if separated, will reproduce the body and the tail; and if you cut off the tail, you will find that that will reproduce the body and all the rest of the members, without in any way deviating from the plan of the organism from which these portions have been detached. And so far does this go, that [397] some experimentalists have carefully examined the lower orders of animals,–among them the Abbe Spallanzani, who made a number of experiments upon snails and salamanders,–and have found that they might mutilate them to an incredible extent; that you might cut off the jaw or the greater part of the head, or the leg or the tail, and repeat the experiment several times, perhaps cutting off the same member again and again; and yet each of those types would be reproduced according to the primitive type: Nature making no mistake, never putting on a fresh kind of leg, or head, or tail, but always tending to repeat and to return to the primitive type.

It is the same in sexual reproduction: it is a matter of perfectly common experience, that the tendency on the part of the offspring always is, speaking broadly, to reproduce the form of the parents. The proverb has it that the thistle does not bring forth grapes; so, among ourselves, there is always a likeness, more or less marked and distinct, between children and their parents. That is a matter of familiar and ordinary observation. We notice the same thing occurring in the cases of the domestic animals–dogs, for instance, and their offspring. In all these cases of propagation and perpetuation, there seems to be a tendency in the offspring to take the characters of the parental organisms. To that tendency a special name is given–and as I may very often use it, I will write it [398] up here on this black-board that you may remember it–it is called *Atavism,* it expresses this tendency to revert to the ancestral type, and comes from the Latin word *atavus,* ancestor.

Well, this *Atavism* which I shall speak of, is, as I said before, one of the most marked and striking tendencies of organic beings; but, side by side with this hereditary tendency there is an equally distinct and remarkable tendency to variation. The tendency to reproduce the original stock has, as it were, its limits, and side by side with it there is a tendency to vary in certain directions, as if there were two opposing powers working upon the organic being, one tending to take it in a straight line, and the other tending to make it diverge from that straight line, first to one side and then to the other.

So that you see these two tendencies need not precisely contradict one another, as the ultimate result may not always be very remote from what would have been the case if the line had been quite straight.

This tendency to variation is less marked in that mode of propagation which takes place non-sexually; it is in that mode that the minor characters of animal and vegetable structures are most completely preserved. Still, it will happen sometimes, that the gardener, when he has planted a cutting of some favourite plant, will find, contrary to his expectation, that the slip grows up a little different [399] from the primitive stock–that it produces flowers of a different colour or make, or some deviation in one way or another. This is what is called the "sporting" of plants.

In animals the phenomena of non-sexual propagation are so obscure, that at present we cannot be said to know much about them; but if we turn to that mode of perpetuation which results from the sexual process, then we find variation a perfectly constant occurrence, to a certain extent; and, indeed, I think that a certain amount of variation from the primitive stock is the necessary result of the method of sexual propagation itself; for, inasmuch as the thing propagated proceeds from two organisms of different sexes and different makes and temperaments, and as the offspring is to be either of one sex or the other, it is quite clear that it cannot be an exact diagonal of the two, or it would be of no sex at all; it cannot be an exact intermediate form between that of each of its parents–it must deviate to one side or the other. You do not find that the male follows the precise type of the male parent, nor does the female always inherit the precise characteristics of the mother,–there is always a proportion of the female character in the male offspring, and of the male character in the female offspring. That must be quite plain to all of you who have looked at all attentively on your own children or those of your neighbours; you will have noticed how very often it may hap[400]pen that the son shall exhibit the maternal type of character, or the daughter possess the characteristics of the father's family. There are all sorts of intermixtures and intermediate conditions between the two, where complexion, or beauty, or fifty other different peculiarities belonging to either side of the house, are reproduced in other members of the same family. Indeed, it is sometimes to be remarked in this kind of variation, that the variety belongs, strictly speaking, to neither of the immediate parents; you will see a child in a family who is not like either its father or its mother; but some old person who knew its grandfather or grandmother, or, it may be, an uncle, or, perhaps, even a more distant relative will see a great similarity between the child and one of these. In this way it constantly happens that the characteristic of some previous member of the family comes out and is reproduced and recognised in the most unexpected manner.

But apart from that matter of general experience, there are some cases which put that curious mixture in a very clear light. You are aware that the offspring of the ass and the horse, or rather of the he-ass and the mare, is what is called a mule; and, on the other hand, the offspring of the stallion and the she-ass is what is called a hinny. It is a very rare thing in this country to see a hinny. I never saw one myself; but they have been very carefully studied. Now, the curious thing is this, [401] that although you have the same elements in the experiment in each case, the offspring is entirely different in character, according as the male influence comes from the ass or the horse. Where the ass is the male, as in the case of the mule, you find that the head is like that of the ass, that the ears are long, the tail is tufted at the end, the feet are small, and the voice is an unmistakable bray; these are all points of similarity to the ass; but, on the other hand, the barrel of the body and the cut of the neck are much more like those of the mare. Then, if you look at the hinny,–the result of the union of the stallion and the she-ass, then you find it is the horse that has the predominance; that the head is more like that of the horse, the ears are shorter, the

legs coarser, and the type is altogether altered; while the voice, instead of being a bray, is the ordinary neigh of the horse. Here, you see, is a most curious thing: you take exactly the same elements, ass and horse, but you combine the sexes in a different manner, and the result is modified accordingly. You have in this case, however, a result which is not general and universal–there is usually an important preponderance, but not always on the same side.

Here, then, is one intelligible, and, perhaps, necessary cause of variation: the fact, that there are two sexes sharing in the production of the offspring, and that the share taken by each is different and variable, not only for each combination, [402] but also for different members of the same family.

Secondly, there is a variation, to a certain extent–though, in all probability, the influence of this cause has been very much exaggerated–but there is no doubt that variation is produced, to a certain extent, by what are commonly known as external conditions–such as temperature, food, warmth, and moisture. In the long run, every variation depends, in some sense, upon external conditions, seeing that everything has a cause of its own. I use the term "external conditions" now in the sense in which it is ordinarily employed: certain it is, that external conditions have a definite effect. You may take a plant which has single flowers, and by dealing with the soil, and nourishment, and so on, you may by and by convert single flowers into double flowers, and make thorns shoot out into branches. You may thicken or make various modifications in the shape of the fruit. In animals, too, you may produce analogous changes in this way, as in the case of that deep bronze colour which persons rarely lose after having passed any length of time in tropical countries. You may also alter the development of the muscles very much, by dint of training; all the world knows that exercise has a great effect in this way; we always expect to find the arm of a blacksmith hard and wiry, and possessing a large development of the brachial muscles. No doubt [403] training, which is one of the forms of external conditions, converts what are originally only instructions, teachings, into habits, or, in other words, into organisations, to a great extent; but this second cause of variation cannot be considered to be by any means a large one. The third cause that I have to mention, however, is a very extensive one. It is one that, for want of a better name, has been called "spontaneous variation"; which means that when we do not know anything about the cause of phenomena, we call it spontaneous. In the orderly chain of causes and effects in this world, there are very few things of which it can be said with truth that they are spontaneous. Certainly not in these physical matters–in these there is nothing of the kind–everything depends on previous conditions. But when we cannot trace the cause of phenomena, we call them spontaneous.

Of these variations, multitudinous as they are, but little is known with perfect accuracy. I will mention to you some two or three cases, because they are very remarkable in themselves, and also because I shall want to use them afterwards. Réaumur, a famous French naturalist, a great many years ago, in an essay which he wrote upon the art of hatching chickens–which was indeed a very curious essay–had occasion to speak of variations and monstrosities. One very remarkable case had come under his notice of a variation [404] in the form of a human member, in the person of a Maltese, of the name of Gratio Kelleia, who was born with six fingers upon each hand, and the like number of toes to each of his feet. That was a case of spontaneous variation. Nobody knows why he was born with that number of fingers and toes, and as we don't know, we call it a case of "spontaneous" variation. There is another remarkable case also. I select these, because they happen to have been observed and noted very carefully at the time.

It frequently happens that a variation occurs, but the persons who notice it do not take any care in noting down the particulars, until at length, when inquiries come to be made, the exact circumstances are forgotten; and hence, multitudinous as may be such "spontaneous" variations, it is exceedingly difficult to get at the origin of them.

The second case is one of which you may find the whole details in the "Philosophical Transactions" for the year 1813, in a paper communicated by Colonel Humphrey to the President of the Royal Society–"On a new Variety in the Breed of Sheep," giving an account of a very remarkable breed of sheep, which at one time was well known in the northern states of America, and which went by the name of the Ancon or the Otter breed of sheep. In the year 1791, there was a farmer of the name of Seth Wright in Massachusetts, who had a flock of sheep, consisting of a [405] ram and, I think, of some twelve or thirteen ewes. Of this flock of ewes, one at the breeding-time bore a lamb which was very singularly formed; it had a very long body, very short legs, and those legs were bowed. I will tell you by and by how this singular variation in the breed of sheep came to be noted, and to have the prominence that it now has. For the present, I mention only these two cases; but the extent of variation in the breed of animals is perfectly obvious to any one who has studied natural history with ordinary attention, or to any person who compares animals with others of the same kind. It is strictly true that there are never any two specimens which are exactly alike; however similar, they will always differ in some certain particular.

Now let us go back to Atavism–to the hereditary tendency I spoke of. What will come of a variation when you breed from it, when Atavism comes, if I may say so, to intersect variation? The two cases of which I have mentioned the history give a most excellent illustration of what occurs. Gratio Kelleia, the Maltese, married when he was twenty-two years of age, and, as I suppose there were no six-fingered ladies in Malta, he married an ordinary five-fingered person. The result of that marriage was four children; the first, who was christened Salvator, had six fingers and six toes, like his father; the second was George, who had five fingers and toes, but one of [406] them was deformed, showing a tendency to variation; the third was André; he had five fingers and five toes, quite perfect; the fourth was a girl, Marie; she had five fingers and five toes, but her thumbs were deformed, showing a tendency toward the sixth.

These children grew up, and when they came to adult years, they all married, and of course it happened that they all married five-fingered and five-toed persons. Now let us see what were the results. Salvator had four children; they were two boys, a girl, and another boy; the first two boys and the girl were six-fingered and six-toed like their grandfather; the fourth boy had only five fingers and five toes. George had only four children; there were two girls with six fingers and six toes; there was one girl with six fingers and five toes on the right side, and five fingers and five toes on the left side, so that she was half and half. The last, a boy, had five fingers and five toes. The third, André, you will recollect, was perfectly well-formed, and he had many children whose hands and feet were all regularly developed. Marie, the last, who, of course, married a man who had only five fingers, had four children; the first, a boy, was born with six toes, but the other three were normal.

Now observe what very extraordinary phenomena are presented here. You have an accidental variation

giving rise to what you may call a monstrosity; [407] you have that monstrosity or variation diluted in the first instance by an admixture with a female of normal construction, and you would naturally expect that, in the results of such an union, the monstrosity, if repeated, would be in equal proportion with the normal type; that is to say, that the children would be half and half, some taking the peculiarity of the father, and the others being of the purely normal type of the mother; but you see we have a great preponderance of the abnormal type. Well, this comes to be mixed once more with the pure, the normal type, and the abnormal is again produced in large proportion, notwithstanding the second dilution. Now what would have happened if these abnormal types had intermarried with each other; that is to say, suppose the two boys of Salvator had taken it into their heads to marry their first cousins, the two first girls of George, their uncle? You will remember that these are all of the abnormal type of their grandfather. The result would probably have been, that their offspring would have been in every case a further development of that abnormal type. You see it is only in the fourth, in the person of Marie, that the tendency, when it appears but slightly in the second generation, is washed out in the third, while the progeny of André, who escaped in the first instance, escape altogether.

We have in this case a good example of nature's tendency to the perpetuation of a variation. Here [408] it is certainly a variation which carried with it no use or benefit; and yet you see the tendency to perpetuation may be so strong, that, notwithstanding a great admixture of pure blood, the variety continues itself up to the third generation, which is largely marked with it. In this case, as I have said, there was no means of the second generation intermarrying with any but five-fingered persons, and the question naturally suggests itself, What would have been the result of such marriage? Réaumur narrates this case only as far as the third generation. Certainly it would have been an exceedingly curious thing if we could have traced this matter any further; had the cousins intermarried, a six-fingered variety of the human race might have been set up.

To show you that this supposition is by no means an unreasonable one, let me now point out what took place in the case of Seth Wright's sheep, where it happened to be a matter of moment to him to obtain a breed or raise a flock of sheep like that accidental variety that I have described–and I will tell you why. In that part of Massachusetts where Seth Wright was living, the fields were separated by fences, and the sheep, which were very active and robust, would roam abroad, and without much difficulty jump over these fences into other people's farms. As a matter of course, this exuberant activity on the part of the sheep constantly gave rise to all sorts of quarrels, bicker[409]ings, and contentions among the farmers of the neighbourhood; so it occurred to Seth Wright who was, like his successors, more or less 'cute, that if he could get a stock of sheep like those with the bandy legs, they would not be able to jump over the fences so readily; and he acted upon that idea. He killed his old ram, and as soon as the young one arrived at maturity, he bred altogether from it. The result was even more striking than in the human experiment which I mentioned just now. Colonel Humphreys testifies that it always happened that the offspring were either pure Ancons or pure ordinary sheep; that in no case was there any mixing of the Ancons with the others. In consequence of this, in the course of a very few years, the farmer was able to get a very considerable flock of this variety, and a large number of them were spread throughout Massachusetts. Most unfortunately, however–I suppose it was because they were so common–nobody took enough notice of them to preserve their skeletons; and although Colonel Humphreys states that he sent a skeleton to the President of the Royal Society at the same time that he forwarded his paper, I am

afraid that the variety has entirely disappeared; for a short time after these sheep had become prevalent in that district, the Merino sheep were introduced; and as their wool was much more valuable, and as they were a quiet race of sheep, and showed no tendency to trespass or jump over fences, the Otter [410] breed of sheep, the wool of which was inferior to that of the Merino, was gradually allowed to die out.

You see that these facts illustrate perfectly well what may be done if you take care to breed from stocks that are similar to each other. After having got a variation, if, by crossing a variation with the original stock, you multiply that variation, and then take care to keep that variation distinct from the original stock, and make them breed together,–then you may almost certainly produce a race whose tendency to continue the variation is exceedingly strong.

This is what is called "selection"; and it is by exactly the same process as that by which Seth Wright bred his Ancon sheep, that our breeds of cattle, dogs, and fowls are obtained. There are some possibilities of exception, but still, speaking broadly, I may say that this is the way in which all our varied races of domestic animals have arisen; and you must understand that it is not one peculiarity or one characteristic alone in which animals may vary. There is not a single peculiarity or characteristic of any kind, bodily or mental, in which offspring may not vary to a certain extent from the parent and other animals.

Among ourselves this is well known. The simplest physical peculiarity is mostly reproduced. I know a case of a woman who has the lobe of one of her ears a little flattened. An ordinary obser[411]ver might scarcely notice it, and yet every one of her children has an approximation to the same peculiarity to some extent. If you look at the other extreme, too, the gravest diseases, such as gout, scrofula, and consumption, may be handed down with just the same certainty and persistence as we noticed in the perpetuation of the bandy legs of the Ancon sheep.

However, these facts are best illustrated in animals, and the extent of the variation, as is well known, is very remarkable in dogs. For example, there are some dogs very much smaller than others; indeed, the variation is so enormous that probably the smallest dog would be about the size of the head of the largest; there are very great variations in the structural forms not only of the skeleton but also in the shape of the skull, and in the proportions of the face and the disposition of the teeth.

The Pointer, the Retriever, Bulldog, and the Terrier differ very greatly, and yet there is every reason to believe that every one of these races has arisen from the same source,–that all the most important races have arisen by this selective breeding from accidental variation.

A still more striking case of what may be done by selective breeding, and it is a better case, because there is no chance of that partial infusion of error to which I alluded, has been studied very carefully by Mr. Darwin,–the case of the domestic pigeons. I dare say there may be some among you [412] who may be pigeon *fanciers,* and I wish you to understand that in approaching the subject, I would speak with all humility and hesitation, as I regret to say that I am not a pigeon fancier. I know it is a great art and mystery, and a thing upon which a man must not speak lightly; but I shall endeavour, as far as my

understanding goes, to give you a summary of the published and unpublished information which I have gained from Mr. Darwin.

Among the enormous variety,–I believe there are somewhere about a hundred and fifty kinds of pigeons,–there are four kinds which may be selected as representing the extremest divergences of one kind from another. Their names are the Carrier, the Pouter, the Fantail, and the Tumbler. In these large diagrams that I have here they are each represented in their relative sizes to each other. This first one is the Carrier; you will notice this large excrescence on its beak; it has a comparatively small head; there is a bare space round the eyes; it has a long neck, a very long beak, very strong legs, large feet, long wings, and so on. The second one is the Pouter, a very large bird, with very long legs and beak. It is called the Pouter because it is in the habit of causing its gullet to swell up by inflating it with air. I should tell you that all pigeons have a tendency to do this at times, but in the Pouter it is carried to an enormous extent. The birds appear to be quite proud of their power of swelling and puffing them[413]selves out in this way; and I think it is about as droll a sight as you can well see to look at a cage full of these pigeons puffing and blowing themselves out in this ridiculous manner.

This diagram is a representation of the third kind I mentioned–the Fantail. It is, you see, a small bird, with exceedingly small legs and a very small beak. It is most curiously distinguished by the size and extent of its tail, which, instead of containing twelve feathers, may have many more,–say thirty, or even more–I believe there are some with as many as forty-two. This bird has a curious habit of spreading out the feathers of its tail in such a way that they reach forward and touch its head; and if this can be accomplished, I believe it is looked upon as a point of great beauty.

But here is the last great variety,–the Tumbler; and of that great variety, one of the principal kinds, and one most prized, is the specimen represented here–the short-faced Tumbler. Its beak, you see, is reduced to a mere nothing. Just compare the beak of this one and that of the first one, the Carrier–I believe the orthodox comparison of the head and beak of a thoroughly well-bred Tumbler is to stick an oat into a cherry, and that will give you the proper relative proportions of the beak and head. The feet and legs are exceedingly small, and the bird appears to be quite a dwarf when placed side by side with this great Carrier.

These are differences enough in regard to their [414] external appearance; but these differences are by no means the whole or even the most important of the differences which obtain between these birds. There is hardly a single point of their structure which has not become more or less altered; and to give you an idea of how extensive these alterations are, I have here some very good skeletons, for which I am indebted to my friend, Mr. Tegetmeier, a great authority in these matters; by means of which, if you examine them by and by, you will be able to see the enormous difference in their bony structures.

I had the privilege, some time ago, of access to some important MSS. of Mr. Darwin, who, I may tell you, has taken very great pains and spent much valuable time and attention on the investigation of these variations, and getting together all the facts that bear upon them. I obtained from these MSS. the following summary of the differences between the domestic breeds of pigeons; that is to say, a

notification of the various points in which their organisation differs. In the first place, the back of the skull may differ a good deal, and the development of the bones of the face may vary a great deal; the back varies a good deal; the shape of the lower jaw varies; the tongue varies very greatly, not only in correlation to the length and size of the beak, but it seems also to have a kind of independent variation of its own. Then the amount of naked skin round the eyes, [415] and at the base of the beak, may vary enormously; so may the length of the eyelids, the shape of the nostrils, and the length of the neck. I have already noticed the habit of blowing out the gullet, so remarkable in the Pouter, and comparatively so in the others. There are great differences, too, in the size of the female and the male, the shape of the body, the number and width of the processes of the ribs, the development of the ribs, and the size, shape, and development of the breastbone. We may notice, too–and I mention the fact because it has been disputed by what is assumed to be high authority,–the variation in the number of the sacral vertebræ. The number of these varies from eleven to fourteen, and that without any diminution in the number of the vertebræ of the back or of the tail. Then the number and position of the tail-feathers may vary enormously, and so may the number of the primary and secondary feathers of the wings. Again, the length of the feet and of the beak,–although they have no relation to each other, yet appear to go together,–that is, you have a long beak wherever you have long feet. There are differences also in the periods of the acquirement of the perfect plumage–the size and shape of the eggs–the nature of flight, and the powers of flight–so-called "*homing*" birds having enormous flying powers[2]; [416] while, on the other hand, the little Tumbler is so called because of its extraordinary faculty of turning head over heels in the air, instead of pursuing a direct course. And, lastly, the dispositions and voices of the birds may vary. Thus the case of the pigeons shows you that there is hardly a single particular–whether of instinct, or habit, or bony structure, or of plumage–of either the internal economy or the external shape, in which some variation or change may not take place, which, by selective breeding, may become perpetuated, and form the foundation of, and give rise to, a new race.

If you carry in your mind's eye these four varieties of pigeons, you will bear with you as good a notion as you can have, perhaps, of the enormous extent to which a deviation from a primitive type may be carried by means of this process of selective breeding.[3]

[417] V

The Conditions of Existence as Affecting the Perpetuation of Living Beings

In the last Lecture I endeavoured to prove to you that, while, as a general rule, organic beings tend to reproduce their kind, there is in them, also, a constantly recurring tendency to vary–to vary to a greater or to a less extent. Such a variety, I pointed out to you, might arise from causes which we do not understand; we therefore called it spontaneous; and it might come into existence as a definite and marked thing, without any gradations between itself and the form which preceded it. I further pointed out, that such a variety having once arisen, might be perpetuated to some extent, and indeed to a very marked extent, without any direct interference, or without any exercise of that process which we called selection. And then I stated further, that by such selection, when exercised artificially–if you took care to breed only from those forms which presented the same peculiarities of any [418] variety which had

arisen in this manner–the variation might be perpetuated, as far as we can see, indefinitely.

The next question, and it is an important one for us, is this: Is there any limit to the amount of variation from the primitive stock which can be produced by this process of selective breeding? In considering this question, it will be useful to class the characteristics, in respect of which organic beings vary, under two heads: we may consider structural characteristics, and we may consider physiological characteristics.

In the first place, as regards structural characteristics, I endeavoured to show you, by the skeletons which I had upon the table, and by reference to a great many well-ascertained facts, that the different breeds of Pigeons, the Carriers, Pouters, and Tumblers, might vary in any of their internal and important structural characters to a very great degree; not only might there be changes in the proportions of the skull, and the characters of the feet and beaks, and so on; but that there might be an absolute difference in the number of the vertebræ of the back, as in the sacral vertebræ of the Pouter; and so great is the extent of the variation in these and similar characters that I pointed out to you, by reference to the skeletons and the diagrams, that these extreme varieties may absolutely differ more from one another in their structural characters than do what naturalists [419] call distinct Species of pigeons; that is to say, that they differ so much in structure that there is a greater difference between the Pouter and the Tumbler than there is between such wild and distinct forms as the Rock Pigeon or the Ring Pigeon, or the Ring Pigeon and the Stock Dove; and indeed the differences are of greater value than this, for the structural differences between these domesticated pigeons are such as would be admitted by a naturalist, supposing he knew nothing at all about their origin, to entitle them to constitute even distinct genera.

As I have used this term Species, and shall probably use it a good deal, I had better perhaps devote a word or two to explaining what I mean by it.

Animals and plants are divided into groups, which become gradually smaller, beginning with a Kingdom, which is divided into Sub-Kingdoms; then come the smaller divisions called Provinces; and so on from a Province to a Class, from a Class to an Order, from Orders to Families, and from these to Genera, until we come at length to the smallest groups of animals which can be defined one from the other by constant characters, which are not sexual; and these are what naturalists call Species in practice, whatever they may do in theory.

If, in a state of nature, you find any two groups of living beings, which are separated one from the other by some constantly-recurring characteristic, [420] I don't care how slight and trivial, so long as it is defined and constant, and does not depend on sexual peculiarities, then all naturalists agree in calling them two species; that is what is meant by the use of the word species–that is to say, it is, for the practical naturalist, a mere question of structural differences.[4]

We have seen now–to repeat this point once more, and it is very essential that we should rightly understand it–we have seen that breeds, known to have been derived from a common stock by selection, may be as different in their structure from the original stock as species may be distinct from each other.

But is the like true of the physiological characteristics of animals? Do the physiological differences of varieties amount in degree to those observed between forms which naturalists call distinct species? This is a most important point for us to consider.

As regards the great majority of physiological characteristics, there is no doubt that they are capable of being developed, increased, and modified by selection.

There is no doubt that breeds may be made as different as species in many physiological characters. I have already pointed out to you very [421] briefly the different habits of the breeds of Pigeons, all of which depend upon their physiological peculiarities–as the peculiar habit of tumbling, in the Tumbler–the peculiarities of flight, in the "homing" birds–the strange habit of spreading out the tail, and walking in a peculiar fashion, in the Fantail–and, lastly, the habit of blowing out the gullet, so characteristic of the Pouter. These are all due to physiological modifications, and in all these respects these birds differ as much from each other as any two ordinary species do.

So with Dogs in their habits and instincts. It is a physiological peculiarity which leads the Greyhound to chase its prey by sight–that enables the Beagle to track it by the scent–that impels the Terrier to its rat-hunting propensity–and that leads the Retriever to its habit of retrieving. These habits and instincts are all the results of physiological differences and peculiarities, which have been developed from a common stock, at least there is every reason to believe so. But it is a most singular circumstance, that while you may run through almost the whole series of physiological processes, without finding a check to your argument, you come at last to a point where you do find a check, and that is in the reproductive processes. For there is a most singular circumstance in respect to natural species–at least about some of them–and it would be sufficient [422] for the purposes of this argument if it were true of only one of them, but there is, in fact, a great number of such cases–and that is, that, similar as they may appear to be to mere races or breeds, they present a marked peculiarity in the reproductive process. If you breed from the male and female of the same race, you of course have offspring of the like kind, and if you make the offspring breed together, you obtain the same result, and if you breed from these again, you will still have the same kind of offspring; there is no check. But if you take members of two distinct species, however similar they may be to each other and make them breed together, you will find a check, with some modifications and exceptions, however, which I shall speak of presently. If you cross two such species with each other, then–although you may get offspring in the case of the first cross, yet, if you attempt to breed from the products of that crossing, which are what are called Hybrids–that is, if you couple a male and a female hybrid–then the result is that in ninety-nine cases out of a hundred you will get no offspring at all; there will be no result whatsoever.

The reason of this is quite obvious in some cases; the male hybrids, although possessing all the external appearances and characteristics of perfect animals, are physiologically imperfect and deficient in the structural parts of the reproductive [423] elements necessary to generation. It is said to be invariably the case with the male mule, the cross between the Ass and the Mare; and hence it is, that, although crossing the Horse with the Ass is easy enough, and is constantly done, as far as I am aware, if you take two mules, a male and a female, and endeavour to breed from them, you get no offspring whatever; no generation will take place. This is what is called the sterility of the hybrids between two distinct species.

You see that this is a very extraordinary circumstance; one does not see why it should be. The common teleological explanation is, that it is to prevent the impurity of the blood resulting from the crossing of one species with another, but you see it does not in reality do anything of the kind. There is nothing in this fact that hybrids cannot breed with each other, to establish such a theory; there is nothing to prevent the Horse breeding with the Ass, or the Ass with the Horse. So that this explanation breaks down, as a great many explanations of this kind do, that are only founded on mere assumptions.

Thus you see that there is a great difference between "mongrels," which are crosses between distinct races, and "hybrids," which are crosses between distinct species. The mongrels are, so far as we know, fertile with one another. But between species, in many cases, you cannot succeed in obtaining even the first cross; at any rate [424] it is quite certain that the hybrids are often absolutely infertile one with another.

Here is a feature, then, great or small as it may be, which distinguishes natural species of animals. Can we find any approximation to this in the different races known to be produced by selective breeding from a common stock? Up to the present time the answer to that question is absolutely a negative one. As far as we know at present, there is nothing approximating to this check. In crossing the breeds between the Fantail and the Pouter, the Carrier and the Tumbler, or any other variety or race you may name–so far as we know at present–there is no difficulty in breeding together the mongrels. Take the Carrier and the Fantail, for instance, and let them represent the Horse and the Ass in the case of distinct species; then you have, as the result of their breeding, the Carrier-Fantail mongrel,–we will say the male and female mongrel,–and, as far as we know, these two when crossed would not be less fertile than the original cross, or than Carrier with Carrier. Here, you see, is a physiological contrast between the races produced by selective modification and natural species. I shall inquire into the value of this fact, and of some modifying circumstances by and by; for the present I merely put it broadly before you.

But while considering this question of the limitations of species, a word must be said about what [425] is called Recurrence–the tendency of races which have been developed by selective breeding from varieties to return to their primitive type. This is supposed by many to put an absolute limit to the extent of selective and all other variations. People say, "It is all very well to talk about producing these different races, but you know very well that if you turned all these birds wild, these Pouters, and Carriers, and so on, they would all return to their primitive stock." This is very commonly assumed to be a fact, and it is an argument that is commonly brought forward as conclusive; but if you will take the trouble to inquire into it rather closely, I think you will find that it is not worth very much. The first question of course is, Do they thus return to the primitive stock? And commonly as the thing is assumed and accepted, it is extremely difficult to get anything like good evidence of it. It is constantly said, for example, that if domesticated Horses are turned wild, as they have been in some parts of Asia Minor and South America, that they return at once to the primitive stock from which they were bred. But the first answer that you make to this assumption is, to ask who knows what the primitive stock was; and the second answer is, that in that case the wild Horses of Asia Minor ought to be exactly like the wild Horses of South America. If they are both like the same thing, they ought manifestly to be like each other! The best authorities, [426] however, tell you that it is quite different. The wild Horse of Asia is

said to be of a dun colour, with a largish head, and a great many other peculiarities; while the best authorities on the wild Horses of South America tell you that there is no similarity between their wild Horses and those of Asia Minor; the cut of their heads is very different, and they are commonly chestnut or bay-coloured. It is quite clear, therefore, that as by these facts there ought to have been two primitive stocks, they go for nothing in support of the assumption that races recur to one primitive stock, and so far as this evidence is concerned, it falls to the ground.

Suppose for a moment that it were so, and that domesticated races, when turned wild, did return to some common condition, I cannot see that this would prove much more than that similar conditions are likely to produce similar results; and that when you take back domesticated animals into what we call natural conditions, you do exactly the same thing as if you carefully undid all the work you had gone through, for the purpose of bringing the animal from its wild to its domesticated state. I do not see anything very wonderful in the fact, if it took all that trouble to get it from a wild state, that it should go back into its original state as soon as you removed the conditions which produced the variation to the domesticated form. There is an important fact, [427] however, forcibly brought forward by Mr. Darwin, which has been noticed in connection with the breeding of domesticated pigeons; and it is, that however different these breeds of pigeons may be from each other, and we have already noticed the great differences in these breeds, that if, among any of those variations, you chance to have a blue pigeon turn up, it will be sure to have the black bars across the wings, which are characteristic of the original wild stock, the Rock Pigeon.

Now, this is certainly a very remarkable circumstance; but I do not see myself how it tells very strongly either one way or the other. I think, in fact, that this argument in favour of recurrence to the primitive type might prove a great deal too much for those who so constantly bring it forward. For example, Mr. Darwin has very forcibly urged, that nothing is commoner than if you examine a dun horse–and I had an opportunity of verifying this illustration lately while in the islands of the West Highlands, where there are a great many dun horses–to find that horse exhibit a long black stripe down his back, very often stripes on his shoulder, and very often stripes on his legs. I, myself, saw a pony of this description a short time ago, in a baker's cart, near Rothesay, in Bute: it had the long stripe down the back, and stripes on the shoulders and legs, just like those of the Ass, the Quagga, and the Zebra. Now, if we interpret the theory of recurrence as [428] applied to this case, might it not be said that here was a case of a variation exhibiting the characters and conditions of an animal occupying something like an intermediate position between the Horse, the Ass, the Quagga, and the Zebra, and from which these had been developed? In the same way with regard even to Man. Every anatomist will tell you that there is nothing commoner, in dissecting the human body, than to meet with what are called muscular variations–that is, if you dissect two bodies very carefully, you will probably find that the modes of attachment and insertion of the muscles are not exactly the same in both, there being great peculiarities in the mode in which the muscles are arranged; and it is very singular, that in some dissections of the human body you will come upon arrangements of the muscles very similar indeed to the same parts in the Apes. Is the conclusion in that case to be, that this is like the black bars in the case of the Pigeon, and that it indicates a recurrence to the primitive type from which the animals have been probably developed? Truly, I think that the opponents of modification and variation had better leave the argument of recurrence alone, or it may prove altogether too strong for them.

To sum up,–the evidence as far as we have gone is against the argument as to any limit to divergences, so far as structure is concerned; and [429] in favour of a physiological limitation. By selective breeding we can produce structural divergences as great as those of species, but we cannot produce equal physiological divergences. For the present I leave the question there.

Now, the next problem that lies before us–and it is an extremely important one–is this: Does this selective breeding occur in nature? Because, if there is no proof of it, all that I have been telling you goes for nothing in accounting for the origin of species. Are natural causes competent to play the part of selection in perpetuating varieties? Here we labour under very great difficulties. In the last lecture I had occasion to point out to you the extreme difficulty of obtaining evidence even of the first origin of those varieties which we know to have occurred in domesticated animals. I told you, that almost always the origin of these varieties is overlooked, so that I could only produce two or three cases, as that of Gratio Kelleia and of the Ancon sheep. People forget, or do not take notice of them until they come to have a prominence; and if that is true of artificial cases, under our own eyes, and in animals in our own care, how much more difficult it must be to have at first hand good evidence of the origin of varieties in nature! Indeed, I do not know that it is possible by direct evidence to prove the origin of a variety in nature, or to prove selective breeding; but I will tell you what we [430] can prove–and this comes to the same thing–that varieties exist in nature within the limits of species, and, what is more, that when a variety has come into existence in nature, there are natural causes and conditions, which are amply competent to play the part of a selective breeder; and although that is not quite the evidence that one would like to have–though it is not direct testimony–yet it is exceeding good and exceedingly powerful evidence in its way.

As to the first point, of varieties existing among natural species, I might appeal to the universal experience of every naturalist, and of any person who has ever turned any attention at all to the characteristics of plants and animals in a state of nature; but I may as well take a few definite cases, and I will begin with Man himself.

I am one of those who believe that, at present, there is no evidence whatever for saying, that mankind sprang originally from any more than a single pair; I must say, that I cannot see any good ground whatever, or even any tenable sort of evidence, for believing that there is more than one species of Man. Nevertheless, as you know, just as there are numbers of varieties in animals, so there are remarkable varieties of men. I speak not merely of those broad and distinct variations which you see at a glance. Everybody, of course, knows the difference between a Negro and a white [431] man, and can tell a Chinaman from an Englishman. They each have peculiar characteristics of colour and physiognomy; but you must recollect that the characters of these races go very far deeper–they extend to the bony structure, and to the characters of that most important of all organs to us–the brain; so that, among men belonging to different races, or even within the same race, one man shall have a brain a third, or half, or even seventy per cent. bigger than another; and if you take the whole range of human brains, you will find a variation in some cases of a hundred per cent. Apart from these variations in the size of the brain, the characters of the skull vary. Thus if I draw the figures of a Mongol and of a Negro head on the blackboard, in the case of the last the breadth would be about seven-tenths, and in the other it would be

nine-tenths of the total length. So that you see there is abundant evidence of variation among men in their natural condition. And if you turn to other animals there is just the same thing. The fox, for example, which has a very large geographical distribution all over Europe, and parts of Asia, and on the American Continent, varies greatly. There are mostly large foxes in the North, and smaller ones in the South. In Germany alone the foresters reckon some eight different sorts.

Of the tiger, no one supposes that there is more than one species; they extend from the hottest [432] parts of Bengal, into the dry, cold, bitter steppes of Siberia, into a latitude of 50°,–so that they may even prey upon the reindeer. These tigers have exceedingly different characteristics, but still they all keep their general features, so that there is no doubt as to their being tigers. The Siberian tiger has a thick fur, a small mane, and a longitudinal stripe down the back, while the tigers of Java and Sumatra differ in many important respects from the tigers of Northern Asia. So lions vary; so birds vary; and so, if you go further back and lower down in creation, you find that fishes vary. In different streams, in the same country even, you will find the trout to be quite different to each other and easily recognisable by those who fish in the particular streams. There is the same differences in leeches; leech collectors can easily point out to you the differences and the peculiarities which you yourself would probably pass by; so with fresh-water mussels; so, in fact, with every animal you can mention.

In plants there is the same kind of variation. Take such a case even as the common bramble. The botanists are all at war about it; some of them wanting to make out that there are many species of it, and others maintaining that they are but many varieties of one species; and they cannot settle to this day which is a species and which is a variety!

So that there can be no doubt whatsoever that [433] any plant and any animal may vary in nature; that varieties may arise in the way I have described–as spontaneous varieties–and that those varieties may be perpetuated in the same way that I have shown you spontaneous varieties are perpetuated; I say, therefore, that there can be no doubt as to the origin and perpetuation of varieties in nature.

But the question now is:–Does selection take place in nature? Is there anything like the operation of man in exercising selective breeding, taking place in nature? You will observe that, at present, I say nothing about species; I wish to confine myself to the consideration of the production of those natural races which everybody admits to exist. The question is, whether in nature there are causes competent to produce races, just in the same way as man is able to produce by selection, such races of animals as we have already noticed.

When a variety has arisen, the Conditions of Existence are such as to exercise an influence which is exactly comparable to that of artificial selection. By Conditions of Existence I mean two things–there are conditions which are furnished by the physical, the inorganic world, and there are conditions of existence which are furnished by the organic world. There is, in the first place, Climate; under that head I include only temperature and the varied amount of moisture [434] of particular places. In the next place there is what is technically called Station, which means–given the climate, the particular kind of place in which an animal or a plant lives or grows; for example, the station of a fish is in the water, of a

fresh-water fish in fresh water; the station of a marine fish is in the sea, and a marine animal may have a station higher or deeper. So again with land animals: the differences in their stations are those of different soils and neighbourhoods; some being best adapted to a calcareous, and others to an arenaceous soil. The third condition of existence is Food, by which I mean food in the broadest sense, the supply of the materials necessary to the existence of an organic being; in the case of a plant the inorganic matters, such as carbonic acid, water, ammonia, and the earthy salts or salines; in the case of the animal the inorganic and organic matters, which we have seen they require; then these are all, at least the first two, what we may call the inorganic or physical conditions of existence. Food takes a mid-place, and then come the organic conditions; by which I mean the conditions which depend upon the state of the rest of the organic creation, upon the number and kind of living beings, with which an animal is surrounded. You may class these under two heads: there are organic beings, which operate as *opponents,* and there are organic beings which operate as *helpers* to any given organic creature. [435] The opponents may be of two kinds: there are the *indirect opponents,* which are what we may call *rivals;* and there are the *direct opponents,* those which strive to destroy the creature; and these we call *enemies.* By rivals I mean, of course, in the case of plants, those which require for their support the same kind of soil and station, and, among animals, those which require the same kind of station, or food, or climate; those are the indirect opponents; the direct opponents are, of course, those which prey upon an animal or vegetable. The *helpers* may also be regarded as direct and indirect: in the case of a carnivorous animal, for example, a particular herbaceous plant may, in multiplying, be an indirect helper, by enabling the herbivora on which the carnivore preys to get more food, and thus to nourish the carnivore more abundantly; the direct helper may be best illustrated by reference to some parasitic creature, such as the tape-worm. The tape-worm exists in the human intestines, so that the fewer there are of men the fewer there will be of tape-worms, other things being alike. It is a humiliating reflection, perhaps, that we may be classed as direct helpers to the tape-worm, but the fact is so: we can all see that if there were no men there would be no tape-worms.

It is extremely difficult to estimate, in a proper way, the importance and the working of the Conditions of Existence. I do not think there were any of us who had the remotest notion of properly [436] estimating them until the publication of Mr. Darwin's work, which has placed them before us with remarkable clearness; and I must endeavour, as far as I can in my own fashion, to give you some notion of how they work. We shall find it easiest to take a simple case, and one as free as possible from every kind of complication.

I will suppose, therefore, that all the habitable part of this globe–the dry land, amounting to about 51,000,000 square miles–I will suppose that the whole of that dry land has the same climate, and that it is composed of the same kind of rock or soil, so that there will be the same station everywhere; we thus get rid of the peculiar influence of different climates and stations. I will then imagine that there shall be but one organic being in the world, and that shall be a plant. In this we start fair. Its food is to be carbonic acid, water and ammonia, and the saline matters in the soil, which are, by the supposition, everywhere alike. We take one single plant, with no opponents, no helpers, and no rivals; it is to be a "fair field, and no favour" Now, I will ask you to imagine further that it shall be a plant which shall produce every year fifty seeds, which is a very moderate number for a plant to produce; and that, by the action of the winds and currents, these seeds shall be equally and gradually distributed over the whole

surface of the land. I want you now to trace out what will occur, and you will observe that I am not talking fallaciously [437] any more than a mathematician does when he expounds his problem. If you show that the conditions of your problem are such as may actually occur in Nature and do not transgress any of the known laws of Nature in working out your proposition, then you are as safe in the conclusion you arrive at as is the mathematician in arriving at the solution of his problem. In science, the only way of getting rid of the complications with which a subject of this kind is environed, is to work in this deductive method. What will be the result, then? I will suppose that every plant requires one square foot of ground to live upon; and the result will be that, in the course of nine years, the plant will have occupied every single available spot in the whole globe! I have chalked upon the blackboard the figures by which I arrive at the result:–

Plants.		Plants.
1 x 50 in 1st year	=	50
50 x 50 in 2nd year	=	2,500
2,500 x 50 " 3rd "	=	125,000
125,000 x 50& " 4th "	=	6,250,000
6,250,000 x 50 " 5th "	=	312,500,000
312,500,000 x 50 " 6th "	=	15,625,000,000
15,625,000,000 x 50 " 7th "	=	781,250,000,000
781,250,000,000 x 50 " 8th "	=	39,062,500,000,000
39,062,500,000,000 x 50& " 9th "	=	1,953,125,000,000,000
51,000,000 square miles–the dry surface of the earth x 27,878,400–the number of sq. ft. in 1 sq. mile	=	sq. ft. 1,421,798,400,000,000

being 531,326,600,000,000 square feet less than would be required at the end of the ninth year.

[438] You will see from this that, at the end of the first year the single plant will have produced fifty more of its kind; by the end of the second year these will have increased to 2,500; and so on, in succeeding years, you get beyond even trillions; and I am not at all sure that I could tell you what the proper arithmetical denomination of the total number really is; but, at any rate, you will understand the meaning of all those noughts. Then you see that at the bottom, I have taken the 51,000,000 of square miles, constituting the surface of the dry land; and as the number of square feet are placed under and subtracted from the number of seeds that would be produced in the ninth year, you can see at once that there would be an immense number more of plants than there would be square feet of ground for their accommodation. This is certainly quite enough to prove my point; that between the eighth and ninth year after being planted the single plant would have stocked the whole available surface of the earth.

This is a thing which is hardly conceivable–it seems hardly imaginable–yet it is so. It is indeed simply the law of Malthus exemplified. Mr. Malthus was a clergyman, who worked out this subject most minutely and truthfully some years ago; he showed quite clearly–and although he was much abused for his conclusions at the time, they have never yet been disproved and never will be–he showed that in consequence of [439] the increase in the number of organic beings in a geometrical ratio, while the means of existence cannot be made to increase in the same ratio, that there must come a time when the number of organic beings will be in excess of the power of production of nutriment, and that thus some check must arise to the further increase of those organic beings. At the end of the ninth year we have seen that each plant would not be able to get its full square foot of ground, and at the end of another year it would have to share that space with fifty others the produce of the seeds which it would give off.

What, then, takes place? Every plant grows up, flourishes, occupies its square foot of ground, and gives off its fifty seeds; but notice this, that out of this number only one can come to anything; there is thus, as it were, forty-nine chances to one against its growing up; it depends upon the most fortuitous circumstances whether any one of these fifty seeds shall grow up and flourish, or whether it shall die and perish. This is what Mr. Darwin has drawn attention to, and called the "Struggle for Existence"; and I have taken this simple case of a plant because some people imagine that the phrase seems to imply a sort of fight.

I have taken this plant and shown you that this is the result of the ratio of the increase, the necessary result of the arrival of a time coming for every species when exactly as many members must be [440] destroyed as are born; that is the inevitable ultimate result of the rate of production. Now, what is the result of all this? I have said that there are forty-nine struggling against every one; and it amounts to this, that the smallest possible start given to any one seed may give it an advantage which will enable it to get ahead of all the others; anything that will enable any one of these seeds to germinate six hours before any of the others will, other things being alike, enable it to choke them out altogether. I have shown you that there is no particular in which plants will not vary from each other; it is quite possible that one of our imaginary plants may vary in such a character as the thickness of the integument of its seeds; it might happen that one of the plants might produce seeds having a thinner integument, and that would enable the seeds of that plant to germinate a little quicker than those of any of the others, and those seeds would most inevitably extinguish the forty-nine times as many that were struggling with them.

I have put it in this way, but you see the practical result of the process is the same as if some person had nurtured the one and destroyed the other seeds. It does not matter how the variation is produced, so long as it is once allowed to occur. The variation in the plant once fairly started tends to become hereditary and reproduce itself; the seeds would spread themselves in the same way [441] and take part in the struggle with the forty-nine hundred, or forty-nine thousand, with which they might be exposed. Thus, by degrees, this variety with some slight organic change or modification, must spread itself over the whole surface of the habitable globe, and extirpate or replace the other kinds. That is what is meant by Natural Selection; that is the kind of argument by which it is perfectly demonstrable that the conditions of existence may play exactly the same part for natural varieties as man does for domesticated varieties. No one doubts at all that particular circumstances may be more favourable for one plant and less so for

another, and the moment you admit that, you admit the selective power of nature. Now, although I have been putting a hypothetical case, you must not suppose that I have been reasoning hypothetically. There are plenty of direct experiments which bear out what we may call the theory of natural selection; there is extremely good authority for the statement that if you take the seed of mixed varieties of wheat and sow it, collecting the seed next year and sowing it again, at length you will find that out of all your varieties only two or three have lived, or perhaps even only one. There were one or two varieties which were best fitted to get on, and they have killed out the other kinds in just the same way and with just the same certainty as if you had taken the trouble to remove them. As I have [442] already said, the operation of nature is exactly the same as the artificial operation of man.

But if this be true of that simple case, which I put before you, where there is nothing but the rivalry of one member of a species with others, what must be the operation of selective conditions, when you recollect as a matter of fact, that for every species of animal or plant there are fifty or a hundred species which might all, more or less, be comprehended in the same climate, food, and station;–that every plant has multitudinous animals which prey upon it, and which are its direct opponents; and that these have other animals preying upon them,–that every plant has its indirect helpers in the birds that scatter abroad its seed, and the animals that manure it with their dung;–I say, when these things are considered, it seems impossible that any variation which may arise in a species in nature should not tend in some way or other either to be a little better or worse than the previous stock; if it is a little better it will have an advantage over and tend to extirpate the latter in this crush and struggle; and if it is a little worse it will itself be extirpated.

I know nothing that more appropriately expresses this, than the phrase, "the struggle for existence"; because it brings before your minds, in a vivid sort of way, some of the simplest possible circumstances connected with it. When a struggle is intense there must be some who are [443] sure to be trodden down, crushed, and overpowered by others; and there will be some who just manage to get through only by the help of the slightest accident. I recollect reading an account of the famous retreat of the French troops, under Napoleon, from Moscow. Worn out, tired, and dejected, they at length came to a great river over which there was but one bridge for the passage of the vast army. Disorganised and demoralised as that army was, the struggle must certainly have been a terrible one–every one heeding only himself, and crushing through the ranks and treading down his fellows. The writer of the narrative, who was himself one of those who were fortunate enough to succeed in getting over, and not among the thousands who were left behind or forced into the river, ascribed his escape to the fact that he saw striding onward through the mass a great strong fellow,–one of the French Cuirassiers, who had on a large blue cloak–and he had enough presence of mind to catch and retain a hold of this strong man's cloak. He says, "I caught hold of his cloak, and although he swore at me and cut at and struck me by turns, and at last, when he found he could not shake me off, fell to entreating me to leave go or I should prevent him from escaping, besides not assisting myself, I still kept tight hold of him, and would not quit my grasp until he had at last dragged me through." Here you see was a case of selective saving–if we may [444] so term it–depending for its success on the strength of the cloth of the Cuirassier's cloak. It is the same in nature; every species has its bridge of Beresina; it has to fight its way through and struggle with other species; and when well-nigh overpowered, it may be that the smallest chance, something in its colour, perhaps–the minutest circumstance–will turn the scale one way or the other.

Suppose that by a variation of the black race it had produced the white man at any time–you know that the Negroes are said to believe this to have been the case, and to imagine that Cain was the first white man, and that we are his descendants–suppose that this had ever happened, and that the first residence of this human being was on the West Coast of Africa. There is no great structural difference between the white man and the Negro, and yet there is something so singularly different in the constitution of the two, that the malarias of that country, which do not hurt the black at all, cut off and destroy the white. Then you see there would have been a selective operation performed; if the white man had risen in that way, he would have been selected out and removed by means of the malaria. Now there really is a very curious case of selection of this sort among pigs, and it is a case of selection of colour too. In the woods of Florida there are a great many pigs, and it is a very curious thing that they are all black, every one of them. Professor [445] Wyman was there some years ago, and on noticing no pigs but these black ones, he asked some of the people how it was that they had no white pigs, and the reply was that in the woods of Florida there was a root which they called the Paint Root, and that if the white pigs were to eat any of it, it had the effect of making their hoofs crack, and they died, but if the black pigs ate any of it, it did not hurt them at all. Here was a very simple case of natural selection. A skilful breeder could not more carefully develop the black breed of pigs, and weed out all the white pigs, than the Paint Root does.

To show you how remarkably indirect may be such natural selective agencies as I have referred to, I will conclude by noticing a case mentioned by Mr. Darwin, and which is certainly one of the most curious of its kind. It is that of the Humble Bee. It has been noticed that there are a great many more humble bees in the neighbourhood of towns, than out in the open country; and the explanation of the matter is this: the humble bees build nests, in which they store their honey and deposit the larvæ and eggs. The field mice are amazingly fond of the honey and larvæ; therefore, wherever there are plenty of field mice, as in the country, the humble bees are kept down; but in the neighbourhood of towns, the number of cats which prowl about the fields eat up the field mice, and of course the more mice they eat up the less [446] there are to prey upon the larvæ of the bees–the cats are therefore the Indirect Helpers of the bees![5] Coming back a step farther we may say that the old maids are also indirect friends of the humble bees, and indirect enemies of the field mice, as they keep the cats which eat up the latter! This is an illustration somewhat beneath the dignity of the subject, perhaps, but it occurs to me in passing, and with it I will conclude this lecture.

[447] VI

A Critical Examination of the Position of Mr. Darwin's Work "On the Origin of Species," in Relation to the Complete Theory of the Causes of the Phenomena of Organic Nature

IN the preceding five lectures I have endeavoured to give you an account of those facts, and of those reasonings from facts, which form the data upon which all theories regarding the causes of the phenomena of organic nature must be based. And, although I have had frequent occasion to quote Mr. Darwin as all persons hereafter, in speaking upon these subjects, will have occasion to quote his famous book on the "Origin of Species,"–you must yet remember that, wherever I have quoted him, it has not

been upon theoretical points, or for statements in any way connected with his particular speculations, but on matters of fact, brought forward by himself, or collected by himself, and which appear incidentally in his book. If a man *will* make a book, pro[448]fessing to discuss a single question, an encyclopædia, I cannot help it.

Now, having had an opportunity of considering in this sort of way the different statements bearing upon all theories whatsoever, I have to lay before you, as fairly as I can, what is Mr. Darwin's view of the matter and what position his theories hold, when judged by the principles which I have previously laid down, as deciding our judgments upon all theories and hypotheses.

I have already stated to you that the inquiry respecting the causes of the phenomena of organic nature resolves itself into two problems–the first being the question of the origination of living or organic beings; and the second being the totally distinct problem of the modification and perpetuation of organic beings when they have already come into existence. The first question Mr. Darwin does not touch; he does not deal with it at all; but he says:–"Given the origin of organic matter–supposing its creation to have already taken place, my object is to show in consequence of what laws and what demonstrable properties of organic matter, and of its environments, such states of organic nature as those with which we are acquainted must have come about." This, you will observe, is a perfectly legitimate proposition; every person has a right to define the limits of the inquiry which he sets before himself; and yet it is a most singular thing that in all the multi[449]farious, and, not unfrequently, ignorant attacks which have been made upon the "Origin of Species," there is nothing which has been more speciously criticised than this particular limitation. If people have nothing else to urge against the book, they say–"Well, after all, you see Mr. Darwin's explanation of the 'Origin of Species' is not good for much, because, in the long run, he admits that he does not know how organic matter began to exist. But if you admit any special creation for the first particle of organic matter you may just as well admit it for all the rest; five hundred or five thousand distinct creations are just as intelligible, and just as little difficult to understand, as one." The answer to these cavils is two-fold. In the first place, all human inquiry must stop somewhere; all our knowledge and all our investigation cannot take us beyond the limits set by the finite and restricted character of our faculties, or destroy the endless unknown, which accompanies, like its shadow, the endless procession of phenomenæ. So far as I can venture to offer an opinion on such a matter, the purpose of our being in existence, the highest object that human beings can set before themselves, is not the pursuit of any such chimera as the annihilation of the unknown; but it is simply the unwearied endeavour to remove its boundaries a little further from our little sphere of action.

I wonder if any historian would for a moment [450] admit the objection, that it is preposterous to trouble ourselves about the history of the Roman Empire, because we do not know anything positive about the origin and first building of the city of Rome! Would it be a fair objection to urge, respecting the sublime discoveries of a Newton, or a Kepler, those great philosophers, whose discoveries have been of the profoundest benefit and service to all men–to say to them–"After all that you have told us as to how the planets revolve, and how they are maintained in their orbits, you cannot tell us what is the cause of the origin of the sun, moon, and stars. So what is the use of what you have done?" Yet these objections would not be one whit more preposterous than the objections which have been made to the "Origin of Species." Mr. Darwin, then, had a perfect right to limit his inquiry as he pleased, and the only question

for us–the inquiry being so limited–is to ascertain whether the method of his inquiry is sound or unsound; whether he has obeyed the canons which must guide and govern all investigation, or whether he has broken them; and it was because our inquiry this evening is essentially limited to that question, that I spent a good deal of time in a former lecture (which, perhaps some of you thought might have been better employed), in endeavouring to illustrate the method and nature of scientific inquiry in general. We shall now have to [451] put in practice the principles that I then laid down.

I stated to you in substance, if not in words, that wherever there are complex masses of phenomena to be inquired into, whether they be phenomena of the affairs of daily life, or whether they belong to the more abstruse and difficult problems laid before the philosopher, our course of proceeding in unravelling that complex chain of phenomena with a view to get at its cause, is always the same; in all cases we must invent an hypothesis; we must place before ourselves some more or less likely supposition respecting that cause; and then, having assumed an hypothesis, having supposed cause for the phenomena in question, we must endeavour, on the one hand, to demonstrate our hypothesis, or on the other, to upset and reject it altogether, by testing it in three ways. We must, in the first place, be prepared to prove that the supposed causes of the phenomena exist in nature; that they are what the logicians call *vera causæ*–true causes;–in the next place, we should be prepared to show that the assumed causes of the phenomena are competent to produce such phenomena as those which we wish to explain by them; and in the last place, we ought to be able to show that no other known causes are competent to produce those phenomena. If we can succeed in satisfying these three conditions we shall have demonstrated our hypothesis; or rather I ought to say [452] we shall have proved it as far as certainty is possible for us; for, after all, there is no one of our surest convictions which may not be upset, or at any rate modified by a further accession of knowledge. It was because it satisfied these conditions that we accepted the hypothesis as to the disappearance of the tea-pot and spoons in the case I supposed in a previous lecture; we found that our hypothesis on that subject was tenable and valid, because the supposed cause existed in nature, because it was competent to account for the phenomena, and because no other known cause was competent to account for them; and it is upon similar grounds that any hypothesis you choose to name is accepted in science as tenable and valid.

What is Mr. Darwin's hypothesis? As I apprehend it–for I have put it into a shape more convenient for common purposes than I could find *verbatim* in his book–as I apprehend it, I say, it is, that all the phenomena of organic nature, past and present, result from, or are caused by, the inter-action of those properties of organic matter, which we have called Atavism and Variability, with the Conditions of Existence, or, in other words, given the existence of organic matter, its tendency to transmit its properties, and its tendency occasionally to vary; and, lastly, given the conditions of existence by which organic matter is surrounded–that these put together are the [453] causes of the Present and of the Past conditions of Organic Nature.

Such is the hypothesis as I understand it. Now let us see how it will stand the various tests which I laid down just now. In the first place, do these supposed causes of the phenomena exist in nature? Is it the fact that, in nature, these properties of organic matter–atavism and variability–and those phenomena which we have called the conditions of existence,–is it true that they exist? Well, of course, if they do not exist, all that I have told you in the last three or four lectures must be incorrect, because I have been

attempting to prove that they do exist, and I take it that there is abundant evidence that they do exist; so far, therefore, the hypothesis does not break down.

But in the next place comes a much more difficult inquiry:–Are the causes indicated competent to give rise to the phenomena of organic nature? I suspect that this is indubitable to a certain extent. It is demonstrable, I think, as I have endeavoured to show you, that they are perfectly competent to give rise to all the phenomena which are exhibited by Races in nature. Furthermore, I believe that they are quite competent to account for all that we may call purely structural phenomena which are exhibited by Species in nature. On that point also I have already enlarged somewhat. Again, I think that the causes assumed are competent to account for most of the [454] physiological characteristics of species, and I not only think that they are competent to account for them, but I think that they account for many things which otherwise remain wholly unaccountable and inexplicable, and I may say incomprehensible. For a full exposition of the grounds on which this conviction is based, I must refer you to Mr. Darwin's work; all that I can do now is to illustrate what I have said by two or three cases taken almost at random.

I drew your attention, on a previous evening, to the facts which are embodied in our systems of Classification, which are the results of the examination and comparison of the different members of the animal kingdom one with another. I mentioned that the whole of the animal kingdom is divisible into five sub-kingdoms; that each of these sub-kingdoms is again divisible into provinces; that each province may be divided into classes, and the classes into the successively smaller groups, orders, families, genera, and species.

Now, in each of these groups the resemblance in structure among the members of the group is closer in proportion as the group is smaller. Thus, a man and a worm are members of the animal kingdom in virtue of certain apparently slight though really fundamental resemblances which they present. But a man and a fish are members of the same sub-kingdom *Vertebrata* because they are much more like one another than either of them [455] is to a worm, or a snail, or any member of the other sub-kingdoms. For similar reasons men and horses are arranged as members of the same Class, *Mammalia;* men and apes as members of the same Order, *Primates;* and if there were any animals more like men than they were like any of the apes, and yet different from men in important and constant particulars of their organisation, we should rank them as members of the same Family, or of the same Genus, but as of distinct Species.

That it is possible to arrange all the varied forms of animals into groups, having this sort of singular subordination one to the other, is a very remarkable circumstance; but, as Mr. Darwin remarks, this is a result which is quite to be expected, if the principles which he lays down be correct. Take the case of the races which are known to be produced by the operation of atavism and variability, and the conditions of existence which check and modify these tendencies. Take the case of the pigeons that I brought before you; there it was shown that they might be all classed as belonging to some one of five principal divisions, and that within these divisions other subordinate groups might be formed. The members of these groups are related to one another in just the same way as the genera of a family, and the groups themselves as the families of an order, or the orders of a class; while all have the same sort of structural relations with the wild rock-pigeon, [456] as the members of any great natural group have with a real or imaginary typical form. Now, we know that all varieties of pigeons of every kind have arisen by a

process of selective breeding from a common stock, the rock-pigeons; hence, you see, that if all species of animals have proceeded from some common stock, the general character of their structural relations, and of our systems of classification, which express those relations, would be just what we find them to be. In other words, the hypothetical cause is, so far, competent to produce effects similar to those of the real cause.

Take, again, another set of very remarkable facts,–the existence of what are called rudimentary organs, organs for which we can find no obvious use, in the particular animal economy in which they are found, and yet which are there.

Such are the splint-like bones in the leg of the horse, which I here show you, and which correspond with bones which belong to certain toes and fingers in the human hand and foot. In the horse you see they are quite rudimentary, and bear neither toes nor fingers; so that the horse has only one "finger" in his fore-foot and one "toe" in his hind foot. But it is a very curious thing that the animals closely allied to the horse show more toes than he; as the rhinoceros, for instance: he has these extra toes well formed, and anatomical facts show very clearly that he is very closely [457] related to the horse indeed. So we may say that animals, in an anatomical sense nearly related to the horse, have those parts which are rudimentary in him fully developed.

Again, the sheep and the cow have no cutting-teeth, but only a hard pad in the upper jaw. That is the common characteristic of ruminants in general. But the calf has in its upper jaw some rudiments of teeth which never are developed, and never play the part of teeth at all. Well, if you go back in time, you find some of the older, now extinct, allies of the ruminants have well-developed teeth in their upper jaws; and at the present day the pig (which is in structure closely connected with ruminants) has well-developed teeth in its upper jaw; so that here is another instance of organs well-developed and very useful, in one animal, represented by rudimentary organs, for which we can discover no purpose whatsoever in another closely allied animal. The whalebone whale, again, has horny "whalebone" plates in its mouth, and no teeth; but the young fœtal whale before it is born has teeth in its jaws; they, however, are never used, and they never come to anything. But other members of the group to which the whale belongs have well-developed teeth in both jaws.

Upon any hypothesis of special creation, facts of this kind appear to me to be entirely unaccountable and inexplicable, but they cease to be so if [458] you accept Mr. Darwin's hypothesis, and see reason for believing that the whalebone whale and the whale with teeth in its mouth both sprang from a whale that had teeth, and that the teeth of the fœtal whale are merely remnants–recollections, if we may so say–of the extinct whale. So in the case of the horse and the rhinoceros: suppose that both have descended by modification from some earlier form which had the normal number of toes, and the persistence of the rudimentary bones which no longer support toes in the horse becomes comprehensible.

In the language that we speak in England, and in the language of the Greeks, there are identical verbal roots, or elements entering into the composition of words. That fact remains unintelligible so long as we suppose English and Greek to be independently created tongues; but when it is shown that both

languages are descended from one original, we give an explanation of that resemblance. In the same way the existence of identical structural roots, if I may so term them, entering into the composition of widely different animals, is striking evidence in favour of the descent of those animals from a common original.

To turn to another kind of illustration:–If you regard the whole series of stratified rocks–that enormous thickness of sixty or seventy thousand feet that I have mentioned before, constituting the [459] only record we have of a most prodigious lapse of time, that time being, in all probability, but a fraction of that of which we have no record,–if you observe in these successive strata of rocks successive groups of animals arising and dying out, a constant succession, giving you the same kind of impression, as you travel from one group of strata to another, as you would have in travelling from one country to another;–when you find this constant succession of forms, their traces obliterated except to the man of science–when you look at this wonderful history, and ask what it means, it is only a paltering with words if you are offered the reply–"They were so created."

But if, one the other hand, you look on all forms of organised beings as the results of the gradual modification of a primitive type, the facts receive a meaning, and you see that these older conditions are the necessary predecessors of the present. Viewed in this light the facts of palæontology receive a meaning–upon any other hypothesis I am unable to see, in the slightest degree, what knowledge or signification we are to draw out of them. Again, note as bearing upon the same point, the singular likeness which obtains between the successive Faunæ and Floræ, whose remains are preserved on the rocks: you never find any great and enormous difference between the immediately successive Faunæ and [460] Floræ, unless you have reason to believe there has also been a great lapse of time or a great change of conditions. The animals, for instance, of the newest tertiary rocks, in any part of the world, are always, and without exception, found to be closely allied with those which now live in that part of the world. For example, in Europe, Asia, and Africa, the large mammals are at present rhinoceroses, hippopotamuses, elephants, lions, tigers, oxen, horses, &c.; and if you examine the newest tertiary deposits, which contain the animals and plants which immediately preceded those which now exist in the same country, you do not find gigantic specimens of ant-eaters and kangaroos, but you find rhinoceroses, elephants, lions, tigers, &c.,–of different species to those now living–but still their close allies. If you turn to South America, where, at the present day, we have great sloths and armadilloes and creatures of that kind, what do you find in the newest tertiaries? You find the great sloth-like creature, the *Megatherium,* and the great armadillo, the *Glyptodon,* and so on. And if you go to Australia you find the same law holds good, namely, that that condition of organic nature which has preceded the one which now exists, presents differences perhaps of species, and of genera, but that the great types of organic structure are the same as those which now flourish.

What meaning has this fact upon any other [461] hypothesis or supposition than one of successive modification? But if the population of the world, in any age, is the result of the gradual modification of the forms which peopled it in the preceding age–if that has been the case, it is intelligible enough; because we may expect that the creature that results from the modification of an elephantine mammal shall be something like an elephant, and the creature which is produced by the modification of an armadillo-like mammal shall be like an armadillo. Upon that supposition, I say, the facts are intelligible; upon any other, that I am aware of, they are not.

So far, the facts of palæontology are consistent with almost any form of the doctrine of progressive modification; they would not be absolutely inconsistent with the wild speculations of De Maillet, or with the less objectionable hypothesis of Lamarck. But Mr. Darwin's views have one peculiar merit; and that is, that they are perfectly consistent with an array of facts which are utterly inconsistent with, and fatal to, any other hypothesis of progressive modification which has yet been advanced. It is one remarkable peculiarity of Mr. Darwin's hypothesis that it involves no necessary progression or incessant modification, and that it is perfectly consistent with the persistence for any length of time of a given primitive stock, contemporaneously with its modifications. To return to the case of the domestic breeds of [462] pigeons, for example; you have the dove-cot pigeon, which closely resembles the rock pigeon, from which they all started, existing at the same time with the others. And if species are developed in the same way in nature, a primitive stock and its modifications may, occasionally, all find the conditions fitted for their existence; and though they come into competition, to a certain extent, with one another, the derivative species may not necessarily extirpate the primitive one, or *vice versa.*

Now palæontology shows us many facts which are perfectly harmonious with these observed effects of the process by which Mr. Darwin supposes species to have originated, but which appear to me to be totally inconsistent with any other hypothesis which has been proposed. There are some groups of animals and plants, in the fossil world, which have been said to belong to "persistent types," because they have persisted, with very little change indeed, through a very great range of time, while everything about them has changed largely. There are families of fishes whose type of construction has persisted all the way from the carboniferous strata right up to the cretaceous; and others which have lasted through the whole range of the secondary rocks, and from the lias to the older tertiaries. It is something stupendous this–to consider a genus lasting without essential modifications through all [463] this enormous lapse of time while almost everything else was changed and modified.

Thus I have no doubt that Mr. Darwin's hypothesis will be found competent to explain the majority of the phenomena exhibited by species in nature; but in an earlier lecture I spoke cautiously with respect to its power of explaining all the physiological peculiarities of species.

There is, in fact, one set of these peculiarities which the theory of selective modification, as it stands at present, is not wholly competent to explain, and that is the group of phenomena which I mentioned to you under the name of Hybridism and which I explained to consist in the sterility of the offspring of certain species when crossed one with another. It matters not one whit whether this sterility is universal, or whether it exists only in a single case. Every hypothesis is bound to explain, or, at any rate, not be inconsistent with, the whole of the facts which it professes to account for; and if there is a single one of these facts which can be shown to be inconsistent with (I do not merely mean inexplicable by, but contrary to) the hypothesis, the hypothesis falls to the ground,–it is worth nothing. One fact with which it is positively inconsistent is worth as much, and as powerful in negativing the hypothesis, as five hundred. If I am right in thus defining the obligations of an hypothesis, Mr. Darwin, in order to place his views beyond the reach of all possible [464] assault, ought to be able to demonstrate the possibility of developing from a particular stock by selective breeding, two forms, which should either be unable to cross one with another, or whose cross-bred offspring should be infertile with one another.

For, you see, if you have not done that you have not strictly fulfilled all the conditions of the problem; you have not shown that you can produce, by the cause assumed, all the phenomena which you have in nature. Here are the phenomena of Hybridism staring you in the face, and you cannot say, "I can, by selective modification, produce these same results." Now, it is admitted on all hands that, at present, so far as experiments have gone, it has not been found possible to produce this complete physiological divergence by selective breeding. I stated this very clearly before, and I now refer to the point, because, if it could be proved, not only that this *has* not been done, but that it *cannot* be done; if it could be demonstrated that it is impossible to breed selectively, from any stock, a form which shall not breed with another, produced from the same stock; and if we were shown that this must be the necessary and inevitable results of all experiments, I hold that Mr. Darwin's hypothesis would be utterly shattered.

But has this been done? or what is really the state of the case? It is simply that, so far as we have gone yet with our breeding, we have not pro[465]duced from a common stock two breeds which are not more or less fertile with one another.

I do not know that there is a single fact which would justify any one in saying that any degree of sterility has been observed between breeds absolutely known to have been produced by selective breeding from a common stock. On the other hand, I do not know that there is a single fact which can justify any one in asserting that such sterility cannot be produced by proper experimentation. For my own part, I see every reason to believe that it may, and will be so produced. For, as Mr. Darwin has very properly urged, when we consider the phenomena of sterility, we find they are most capricious; we do not know what it is that the sterility depends on. There are some animals which will not breed in captivity; whether it arises from the simple fact of their being shut up and deprived of their liberty, or not, we do not know, but they certainly will not breed. What an astounding thing this is, to find one of the most important of all functions annihilated by mere imprisonment!

So, again, there are cases known of animals which have been thought by naturalists to be undoubted species, which have yielded perfectly fertile hybrids; while there are other species which present what everybody believes to be varieties[6] [466] which are more or less infertile with one another

There are other cases which are truly extraordinary; there is one, for example which has been carefully examined,–of two kinds of sea-weed, of which the male element of the one, which we may call A, fertilises the female element of the other, B; while the male element of B will not fertilise the female element of A; so that, while the former experiment seems to show us that they are *varieties,* the latter leads to the conviction that they are *species.*

When we see how capricious and uncertain this sterility is, how unknown the conditions on which it depends, I say that we have no right to affirm that those conditions will not be better understood by and by, and we have no ground for supposing that we may not be able to experiment so as to obtain that crucial result which I mentioned just now. So that though Mr. Darwin's hypothesis does not completely extricate us from this difficulty at present, we have not the least right to say it will not do so.

There is a wide gulf between the thing you cannot explain and the thing that upsets you altogether. There is hardly any hypothesis in this world which has not some fact in connection with it which has not been explained, but that is a very different affair to a fact that entirely opposes your [467] hypothesis; in this case all you can say is, that your hypothesis is in the same position as a good many others.

Now, as to the third test, that there are no other causes competent to explain the phenomena, I explained to you that one should be able to say of an hypothesis, that no other known causes than those supposed by it are competent to give rise to the phenomena. Here, I think, Mr. Darwin's view is pretty strong. I really believe that the alternative is either Darwinism or nothing, for I do not know of any rational conception or theory of the organic universe which has any scientific position at all beside Mr. Darwin's. I do not know of any proposition that has been put before us with the intention of explaining the phenomena of organic nature, which has in its favour a thousandth part of the evidence which may be adduced in favour of Mr. Darwin's views. Whatever may be the objections to his views, certainly all other theories are absolutely out of court.

Take the Lamarckian hypothesis, for example. Lamarck was a great naturalist, and to a certain extent went the right way to work; he argued from what was undoubtedly a true cause of some of the phenomena of organic nature. He said it is a matter of experience that an animal may be modified more or less in consequence of its desires and consequent actions. Thus, if a man exercise himself as a blacksmith, his arms will become [468] strong and muscular; such organic modification is a result of this particular action and exercise. Lamarck thought that by a very simple supposition based on this truth he could explain the origin of the various animal species: he said, for example, that the short-legged birds which live on fish had been converted into the long-legged waders by desiring to get the fish without wetting their feathers, and so stretching their legs more and more through successive generations. If Lamarck could have shown experimentally that even races of animals could be produced in this way, there might have been some ground for his speculations. But he could show nothing of the kind, and his hypothesis has pretty well dropped into oblivion, as it deserved to do. I said in an earlier lecture that there are hypotheses and hypotheses; and when people tell you that Mr. Darwin's strongly-based hypothesis is nothing but a mere modification of Lamarck's, you will know what to think of their capacity for forming a judgment on this subject.

But you must recollect that when I say I think it is either Mr. Darwin's hypothesis or nothing; that either we must take his view, or look upon the whole of organic nature as an enigma, the meaning of which is wholly hidden from us; you must understand that I mean that I accept it provisionally, in exactly the same way as I accept any other hypothesis. Men of science do not [469] pledge themselves to creeds; they are bound by articles of no sort; there is not a single belief that it is not a bounden duty with them to hold with a light hand and to part with cheerfully, the moment it is really proved to be contrary to any fact, great or small. And if, in course of time I see good reasons for such a proceeding, I shall have no hesitation in coming before you, and pointing out any change in my opinion without finding the slightest occasion to blush for so doing. So I say that we accept this view as we accept any other, so long as it will help us, and we feel bound to retain it only so long as it will serve our great purpose–the improvement of Man's estate and the widening of his knowledge. The moment this, or any other conception, ceases to be

useful for these purposes, away with it to the four winds; we care not what becomes of it!

But to say truth, although it has been my business to attend closely to the controversies roused by the publication of Mr. Darwin's book, I think that not one of the enormous mass of objections and obstacles which have been raised is of any very great value, except that sterility case which I brought before you just now. All the rest are misunderstandings of some sort, arising either from prejudice, or want of knowledge, or still more from want of patience and care in reading the work.

For you must recollect that it is not a book to [470] be read with as much ease as its pleasant style may lead you to imagine. You spin through it as if it were a novel the first time you read it, and think you know all about it; the second time you read it you think you know rather less about it; and the third time, you are amazed to find how little you have really apprehended its vast scope and object.. I can positively say that I never take it up without finding in it some new view, or light, or suggestion that I have not noticed before. That is the best characteristic of a thorough and profound book; and I believe this feature of the "Origin of Species" explains why so many persons have ventured to pass judgment and criticisms upon it which are by no means worth the paper they are written on.

Before concluding these lectures there is one point to which I must advert–though, as Mr. Darwin has said nothing about man in his book, it concerns myself rather than him;–for I have strongly maintained on sundry occasions that if Mr. Darwin's views are sound, they apply as much to man as to the lower mammals, seeing that it is perfectly demonstrable that the structural differences which separate man from the apes are not greater than those which separate some apes from others. There cannot be the slightest doubt in the world that the argument which applies to the improvement of the horse from an earlier stock, or of ape from ape, applies to the improve[471]ment of man from some simpler and lower stock than man. There is not a single faculty–functional or structural, moral, intellectual, or instinctive, there is no faculty whatever that is not capable of improvement; there is no faculty whatsoever which does not depend upon structure, and as structure tends to vary, it is capable of being improved.

Well, I have taken a good deal of pains at various times to prove this, and I have endeavoured to meet the objections of those who maintain, that the structural differences between man and the lower animals are of so vast a character and enormous extent, that even if Mr. Darwin's views are correct, you cannot imagine this particular modification to take place. It is, in fact, an easy matter to prove that, so far as structure is concerned, man differs to no greater extent from the animals which are immediately below him than these do from other members of the same order. Upon the other hand, there is no one who estimates more highly than I do the dignity of human nature, and the width of the gulf in intellectual and moral matters which lies between man and the whole of the lower creation.

But I find this very argument brought forward vehemently by some. "You say that man has proceeded from a modification of some lower animal, and you take pains to prove that the structural differences which are said to exist in his [472] brain do not exist at all, and you teach that all functions, intellectual, moral, and others, are the expression or the result, in the long run, of structures, and of the molecular forces which they exert." It is quite true that I do so.

"Well, but," I am told at once, somewhat triumphantly, "you say in the same breath that there is a great moral and intellectual chasm between man and the lower animals. How is this possible when you declare that moral and intellectual characteristics depend on structure, and yet tell us that there is no such gulf between the structure of man and that of the lower animals?"

I think that objection is based upon a misconception of the real relations which exist between structure and function, between mechanism and work. Function is the expression of molecular forces and arrangements no doubt; but, does it follow from this, that variation in function so depends upon variation in structure that the former is always exactly proportioned to the latter? If there is no such relation, if the variation in function which follows on a variation in structure may be enormously greater than the variation of the structure, then, you see, the objection falls to the ground.

Take a couple of watches–made by the same maker, and as completely alike as possible; set them upon the table, and the function of each–which is its rate of going–will be performed in [473] the same manner, and you shall be able to distinguish no difference between them; but let me take a pair of pincers, and if my hand is steady enough to do it, let me just lightly crush together the bearings of the balance-wheel, or force to a slightly different angle the teeth of the escapement of one of them, and of course you know the immediate result will be that the watch, so treated, from that moment will cease to go. But what proportion is there between the structural alteration and the functional result? Is it not perfectly obvious that the alteration is of the minutest kind, yet that, slight as it is, it has produced an infinite difference in the performance of the functions of these two instruments?

Well, now, apply that to the present question. What is it that constitutes and makes man what he is? What is it but his power of language–that language giving him the means of recording his experience–making every generation somewhat wiser than its predecessor–more in accordance with the established order of the universe?

What is it but this power of speech, of recording experience, which enables men to be men–looking before and after and, in some dim sense, understanding the working of this wondrous universe–and which distinguishes man from the whole of the brute world? I say that this functional difference is vast, unfathomable, and truly infinite in its consequences; and I say at the same [474] time, that it may depend upon structural differences which shall be absolutely inappreciable to us with our present means of investigation. What is this very speech that we are talking about? I am speaking to you at this moment, but if you were to alter, in the minutest degree, the proportion of the nervous forces now active in the two nerves which supply the muscles of my glottis, I should become suddenly dumb. The voice is produced only so long as the vocal chords are parallel; and these are parallel only so long as certain muscles contract with exact equality; and that again depends on the equality of action of those two nerves I spoke of. So that a change of the minutest kind in the structure of one of these nerves, or in the structure of the part in which it originates, or of the supply of blood to that part, or of one of the muscles to which it is distributed, might render all of us dumb. But a race of dumb men, deprived of all communication with those who could speak, would be little indeed removed from the brutes. And the moral and intellectual difference between them and ourselves would be practically infinite, though the

naturalist should not be able to find a single shadow of even specific structural difference.

But let me dismiss this question now, and, in conclusion, let me say that you may go away with it as my mature conviction, that Mr. Darwin's work is the greatest contribution which has been [475] made to biological science since the publication of the "Régne Animal" of Cuvier, and since that of the "History of Development" of Von Baer. I believe that if you strip it of its theoretical part it still remains one of the greatest encyclopædias of biological doctrine that an since that of the "History of Development" of Von Baer. I believe that if you strip it of its theoretical part it still remains one of the greatest encyclopædias of biological doctrine that an one man ever brought forth; and I believe that, if you take it as the embodiment of an hypothesis, it is destined to be the guide of biological and psychological speculation for the next three or four generations.

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[1] Those who wish to study fully the doctrines of which I have endeavoured to give some rough-and-ready illustrations, must read Mr. John Stuart Mill's *System of Logic*.

[2] The "*Carrier*," I learn from Mr. Tegetmeier, does not *carry;* a high-bred bird of this breed being but a poor flier.

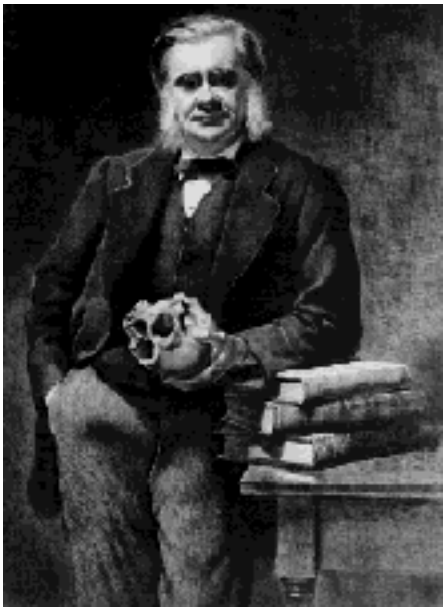
[3] The birds which fly long distances, and come home–"homing" birds–and are consequently used as carriers, are not "carriers" in the fancy sense.

[4] I lay stress here on the *practical* signification of "species." Whether a physiological test between species exist or not, it is hardly ever applicable by the practical naturalist.

[5] The humble bees, on the other hand, are direct helpers of some plants, such as the heartsease and red clover, which are fertilised by the visits of the bees; and they are indirect helpers of the numerous insects which are more or less completely supported by the heartsease and red clover.

[6] And as I conceive with very good reason; but if any objector urges that we cannot prove that they have been produced by artificial or natural selection, the objection must be admitted–ultra-sceptical as it is. But in science, scepticism is a duty.

THE HUXLEY FILE



Preface and Table of Contents to Volume II, *Darwiniana*, of Huxley's *Collected Essays.*

Previous article: Obituary [1888], pages 253-302.

Preface and Table of Contents to Volume III.

C. Blinderman & D. Joyce
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The School Boards: What They Can Do, and What They May Do (1870)

Collected Essays III

[374] An electioneering manifesto would be out of place in the pages of this Review; but any suspicion that may arise in the mind of the reader that the following pages partake of that nature, will be dispelled, if he reflect that they cannot be published[1] until after the day on which the ratepayers of the metropolis will have decided which candidates for seats upon the Metropolitan School Board they will take, and which they will leave.

As one of those candidates, I may be permitted to say, that I feel much in the frame of mind of the Irish bricklayer's labourer, who bet another [375] that he could not carry him to the top of the ladder in his hod. The challenged hodman won his wager, but as the stakes were handed over, the challenger wistfully remarked, "I'd great hopes of falling at the third round from the top." And, in view of the work and the worry which awaits the members of the School Boards, I must confess to an occasional ungrateful hope that the friends who are toiling upwards with me in their hod, may, when they reach "the third round from the top," let me fall back into peace and quietness.

But whether fortune befriend me in this rough method, or not, I should like to submit to those of whom I am potential, but of whom I may not be an actual, colleague, and to others who may be interested in this most important problem–how to get the Education Act to work efficiently–some considerations as to what are the duties of the members of the School Boards, and what are the limits of their power.

I suppose no one will be disposed to dispute the proposition, that the prime duty of every member of such a Board is to endeavour to administer the Act honestly; or in accordance, not only with its letter, but with its spirit. And if so, it would seem that the first step towards this very desirable end is, to obtain a clear notion of what that letter signifies, and what that spirit implies; or, in other words, what the clauses of the Act are intended to enjoin and to forbid. So that it is really not [376] admissible, except for factious and abusive purposes, to assume that any one who endeavours to get at this clear meaning is desirous only of raising quibbles and making difficulties.

Reading the Act with this desire to understand it, I find that its provisions may be classified, as might naturally be expected, under two heads: the one set relating to the subject-matter of education; the other to the establishment, maintenance, and administration of the schools in which that education is to be conducted.

Now it is a most important circumstance, that all the sections of the Act, except four, belong to the latter division; that is, they refer to mere matters of administration. The four sections in question are the seventh, the fourteenth, the sixteenth, and the ninety-seventh. Of these, the seventh, the fourteenth, and the ninety-seventh deal with the subject-matter of education, while the sixteenth defines the nature of the relations which are to exist between the "Education Department" (an euphemism for the future Minister

of Education) and the School Boards. It is the sixteenth clause which is the most important, and, in some respects, the most remarkable of all. It runs thus:–

"If the School Board do, or permit, any act in contravention of, or fail to comply with, the regulations, according to which a school provided by them is required by this Act to be conducted, the Education Department may declare the School [377] Board to be, and such Board shall accordingly be deemed to be, a Board in default, and the Education Department may proceed accordingly; and every act, or omission, of any member of the School Board, or manager appointed by them, or any person under the control of the Board, shall be deemed to be permitted by the Board, unless the contrary be proved.

"If any dispute arises as to whether the School Board have done, or permitted, any act in contravention of, or have failed to comply with, the said regulations, *the matter shall be referred to the Education Department, whose decision thereon shall be final."*

It will be observed that this clause gives the Minister of Education absolute power over the doings of the School Boards. He is not only the administrator of the Act, but he is its interpreter. I had imagined that on the occurrence of a dispute, not as regards a question of pure administration, but as to the meaning of a clause of the Act, a case might be taken and referred to a court of justice. But I am led to believe that the Legislature has, in the present instance, deliberately taken this power out of the hands of the judges and lodged it in those of the Minister of Education, who, in accordance with our method of making Ministers, will necessarily be a political partisan, and who may be a strong theological sectary into the bargain. And I am informed by members of Parliament who watched the progress of the Act, that the responsibility for this unusual state of things rests, not with the Government, but with the Legislature, which exhibited a [378] singular disposition to accumulate power in the hands of the future Minister of Education, and to evade the more troublesome difficulties of the education question by leaving them to be settled between that Minister and the School Boards.

I express no opinion whether it is, or is not, desirable that such powers of controlling all the School Boards in the country should be possessed by a person who may be, like Mr. Forster, eminently likely to use these powers justly and wisely, but who also may be quite the reverse. I merely wish to draw attention to the fact that such powers are given to the Minister, whether he be fit or unfit. The extent of these powers becomes apparent when the other sections of the Act referred to are considered. The fourth clause of the seventh section says:–

"The school shall be conducted in accordance with the conditions required to be fulfilled by an elementary school in order to obtain an annual Parliamentary grant."

What these conditions are appears from the following clauses of the ninety-seventh section:–

"The conditions required to be fulfilled by an elementary school in order to obtain an annual Parliamentary grant shall be those contained in the minutes of the Education Department in force for the time being.... Provided that no such minute of the Education Department, not in force at the time of the passing of this Act, shall be deemed to be in force until it has lain for not less than one month on the table of both Houses of Parliament."

[379] Let us consider how this will work in practice. A school established by a School Board may receive support from three sources–from the rates, the school fees, and the Parliamentary grant. The latter may be as great as the two former taken together; and as it may be assumed, without much risk of error, that a constant pressure will be exerted by the ratepayers on the members who represent them to get as much out of the Government, and as little out of the rates, as possible, the School Boards will have a very strong motive for shaping the education they give, as nearly as may be, on the model which the Education Minister offers for their imitation, and for the copying of which he is prepared to pay.

The Revised Code did not compel any school master to leave off teaching anything; but, by the very simple process of refusing to pay for many kinds of teaching, it has practically put an end to them. Mr. Forster is said to be engaged in revising the Revised Code; a successor of his may re-revise it–and there will be no sort of check upon these revisions and counter revisions, except the possibility of a Parliamentary debate, when the revised, or added, minutes are laid upon the table. What chance is there that any such debate will take place on a matter of detail relating to elementary education–a subject with which members of the Legislature, having been, for the most part, sent to our public schools thirty years ago, [380] have not the least practical acquaintance, and for which they care, unless it derives a political value from its connection with sectarian politics?

I cannot but think, then, that the School Boards will have the appearance, but not the reality, of freedom of action, in regard to the subject-matter of what is commonly called "secular" education.

As respects what is commonly called "religious" education, the power of the Minister of Education is even more despotic. An interest, almost amounting to pathos, attaches itself, in my mind, to the frantic exertions which are at present going on in almost every school division, to elect certain candidates whose names have never before been heard of in connection with education, and who are either sectarian partisans, or nothing. In my own particular division, a body organised *ad hoc* is moving heaven and earth to get the seven seats filled by seven gentlemen, four of whom are good Churchmen, and three no less good Dissenters. But why should this seven times heated fiery furnace of theological zeal be so desirous to shed its genial warmth over the London School Board? Can it be that these zealous sectaries mean to evade the solemn pledge given in the Act?

"No religious catechism or religious formulary which is distinctive of any particular denomination shall be taught in the school."

[381] I confess I should have thought it my duty to reject any such suggestion, as dishonouring to a number of worthy persons, if it had not been for a leading article and some correspondence which appeared in the *Guardian* of November 9th, 1870.

The *Guardian* is, as everybody knows, one of the best of the "religious" newspapers; and, personally, I have every reason to speak highly of the fairness, and indeed kindness, with which the editor is good enough to deal with a writer who must, in many ways, be so objectionable to him as myself. I quote the following passages from a leading article on a letter of mine, therefore, with all respect, and with a

genuine conviction that the course of conduct advocated by the writer must appear to him in a very different light from that under which I see it:–

"The first of these points is the interpretation which Professor Huxley put on the "Cowper-Temple clause.' It is, in fact, that which we foretold some time ago as likely to be forced upon it by those who think with him. The clause itself was one of those compromises which it is very difficult to define or to maintain logically. On the one side was the simple freedom to School Boards to establish what schools they pleased, which Mr. Forster originally gave, but against which the Nonconformists lifted up their voices, because they conceived it likely to give too much power to the Church. On the other side there was the proposition to make the schools secular–intelligible enough, but in the consideration of public opinion simply impossible–and there was the vague impracticable idea, which Mr. Gladstone thoroughly tore to pieces, of enacting that the [382] teaching of all school-masters in the new schools should be strictly 'undenominational.' The Cowper-Temple clause was, we repeat, proposed simply to tide over the difficulty. It was to satisfy the Nonconformists and the 'unsectarian,' as distinct from the secular party of the League, by forbidding all distinctive 'catechisms and formularies,' which might have the effect of openly assigning the schools to this or that religious body. It refused, at the same time, to attempt the impossible task of defining what was undenominational; and its author even contended, if we understood him correctly, that it would in no way, even indirectly, interfere with the substantial teaching of any master in any school. This assertion we always believed to be untenable; we could not see how, in the face of this clause, a distinctly denominational tone could be honestly given to schools nominally general. But beyond this mere suggestion of an attempt at a general tone of comprehensiveness in religious teaching it was not intended to go, and only because such was its limitation was it accepted by the Government and by the House.

"But now we are told that it is to be construed as doing precisely that which it refused to do. A 'formulary,' it seems, is a collection of formulas, and formulas are simply propositions of whatever kind touching religious faith. All such propositions, if they cannot be accepted by all Christian denominations, are to be proscribed; and it is added significantly that the Jews also are a denomination, and so that any teaching distinctively Christian is perhaps to be excluded, lest it should interfere with their freedom and rights. Are we then to fall back on the simple reading of the letter of the Bible? No! this, it is granted, would be an 'unworthy pretence.' The teacher is to give 'grammatical, geographical, or historical explanations;' but he is to keep clear of 'theology proper,' because, as Professor Huxley takes great pains to prove, there is no theological teaching which is not opposed by some sect or other, from Roman Catholicism on the one hand to Unitarianism on the other. It was not, perhaps, hard to see that this difficulty would be started; and to those who, like Professor Huxley look at it theoretically, without much practical experience of schools, [383] it may appear serious or unanswerable. But there is very little in it practically; when it is faced determinately and handled firmly, it will soon shrink into its true dimensions. The class who are least frightened at it are the school teachers, simply because they know most about it. It is quite clear that the school managers must be cautioned against allowing their schools to be made places of proselytism: but when this is done, the case is simple enough. Leave the masters under this general understanding to teach freely; if there is ground of complaint, let it be made, but leave the *onus probandi* on the objectors. For extreme peculiarities of belief or unbelief there is the Conscience Clause; as to the mass of parents, they will be more anxious to have religion taught than afraid of its assuming this or that particular shade. They will trust the school managers and teachers till they have reason to distrust them, and experience has shown that they may trust them safely enough. Any attempt to throw the burden of making the teaching undenominational upon the managers must be sternly resisted: it is simply evading the intentions of the Act in an elaborate attempt to carry them out. We thank Professor Huxley for the warning. To be forewarned is to be forearmed."

A good deal of light seems to me to be thrown on the practical significance of the opinions expressed in

the foregoing extract by the following interesting letter, which appeared in the same paper:–

"SIR,–I venture to send to you the substance of a correspondence with the Education Department upon the question of the lawfulness of religious teaching in rate schools under section 14 (2) of the Act. I asked whether the words 'which is distinctive,' &c., taken grammatically as limiting the prohibition of any religious formulary, might be construed as allowing (subject, however, to the other provisions of the Act) any religious formulary common to any two denominations anywhere in England to be taught in such schools; and if practic[384]ally the limit could not be so extended, but would have to be fixed according to the special circumstances of each district, then what degree of general acceptance in a district would exempt such a formulary from the prohibition? The answer to this was as follows:–'It was understood, when clause 14 of the Education Act was discussed in the House of Commons, that, according to a well-known rule of interpreting Acts of Parliament, "denomination" must be held to include "denominations." When any dispute is referred to the Education Department under the last paragraph of section 16, it will be dealt with according to the circumstances of the case.'

"Upon my asking further if I might hence infer that the lawfulness of teaching any religious formulary in a rate school would thus depend *exclusively* on local circumstances, and would accordingly be so decided by the Education Department in case of dispute, I was informed in explanation that 'their lordships" letter was intended to convey to me that no general rule, beyond that stated in the first paragraph of their letter, could at present be laid down by them; and that their decision in each particular case must depend on the special circumstances accompanying it.

"I think it would appear from this that it may yet be in many cases both lawful and expedient to teach religious formularies in rate schools. H. I.

"Steyning, *November* 5, 1870."

Of course I do not mean to suggest that the editor of the *Guardian* is bound by the opinions of his correspondent; but I cannot help thinking that I do not misrepresent him, when I say that he also thinks "that it may yet be, in many cases, both lawful and expedient to teach religious formularies in rate schools under these circumstances."

It is not uncharitable, therefore, to assume that, the express words of the Act of Parliament not- [385] withstanding, all the sectaries who are toiling so hard for seats in the London School Board have the lively hope of the gentleman from Steyning, that it may be "both lawful and expedient to teach religious formularies in rate schools;" and that they mean to do their utmost to bring this happy consummation about.[2]

Now the pathetic emotion to which I have referred, as accompanying my contemplations of the violent struggles of so many excellent persons, is caused by the circumstance that, so far as I can judge, their labour is in vain.

Supposing that the London School Board contains, as it probably will do, a majority of sectaries; and that they carry over the heads of a minority, a resolution that certain theological formulas, about which

they all happen to agree,–say, for example, the doctrine of the Trinity,–shall be taught in the schools. Do they fondly imagine that the minority will not at once dispute their interpretation of the [386] Act, and appeal to the Education Department to settle that dispute? And if so, do they suppose that any Minister of Education, who wants to keep his place, will tighten boundaries which the Legislature has left loose; and will give a "final decision" which shall be offensive to every Unitarian and to every Jew in the House of Commons, besides creating a precedent which will afterwards be used to the injury of every Nonconformist? The editor of the *Guardian* tells his friends sternly to resist every attempt to throw the burden of making the teaching undenominational on the managers, and thanks me for the warning I have given him. I return the thanks, with interest, for *his* warning, as to the course the party he represents intends to pursue, and for enabling me thus to draw public attention to a perfectly constitutional and effectual mode of checkmating them.

And, in truth, it is wonderful to note the surprising entanglement into which our able editor gets himself in the struggle between his native honesty and judgment and the necessities of his party. "We could not see," says he, "in the face of this clause how a distinct denominational tone could be honestly given to schools nominally general." There speaks the honest and clear-headed man. "Any attempt to throw the burden of making the teaching undenominational must be sternly resisted." There speaks the advocate holding a brief for his party. "Verily," as Trinculo [387] says, "the monster hath two mouths:" the one, the forward mouth, tells us very justly that the teaching cannot "honestly" be "distinctly denominational;" but the other, the backward mouth, asserts that it must by no manner of means be "undenominational." Putting the two utterances together, I can only interpret them to mean that the teaching is to be "indistinctly denominational." If the editor of the *Guardian* had not shown signs of anger at my use of the term "theological fog," I should have been tempted to suppose it must have been what he had in his mind, under the name of "indistinct denominationalism." But this reading being plainly inadmissible, I can only imagine that he inculcates the teaching of formulas common to a number of denominations.

But the Education Department has already told the gentleman from Steyning that any such proceeding will be illegal. "According to a well-known rule of interpreting Acts of Parliament, 'denomination' would be held to include 'denominations.'" In other words, we must read the Act thus:–

"No religious catechism or religious formulary which is distinctive of any particular *denominations* shall be taught."

Thus we are really very much indebted to the editor of the *Guardian* and his correspondent. The one has shown us that the sectaries mean to try to get as much denominational teaching as they can agree upon among themselves, forced into the [388] elementary schools; while the other has obtained a formal declaration from the Educational Department that any such attempt will contravene the Act of Parliament, and that, therefore, the unsectarian, law-abiding members of the School Boards may safely reckon upon bringing down upon their opponents the heavy hand of the Minister of Education.[3]

So much for the powers of the School Boards. Limited as they seem to be, it by no means follows that

such Boards, if they are composed of intelligent and practical men, really more in earnest about education than about sectarian squabbles, may not exert a very great amount of influence. And, from many circumstances, this is especially likely to be the case with the London School Board, which, if it conducts itself wisely, may become a true educational parliament, as subordinate in authority to the Minister of Education, theoretically, as the Legislature is to the Crown, and yet, like the Legislature, possessed of great practical authority. And I suppose that no Minister of Education would be other than glad to have the [389] aid of the deliberations of such a body, or fail to pay careful attention to its recommendations.

What, then, ought to be the nature and scope of the education which a School Board should endeavour to give to every child under its influence, and for which it should try to obtain the aid of the Parliamentary grants? In my judgment it should include at least the following kinds of instruction and of discipline:–

1. Physical training and drill, as part of the regular business of the school.

It is impossible to insist too much on the importance of this part of education for the children of the poor of great towns. All the conditions of their lives are unfavourable to their physical well-being. They are badly lodged, badly housed, badly fed, and live from one year's end to another in bad air, without chance of a change. They have no play-grounds; they amuse themselves with marbles and chuck-farthing, instead of cricket or hare-and-hounds; and if it were not for the wonderful instinct which leads all poor children of tender years to run under the feet of cab-horses whenever they can, I know not how they would learn to use their limbs with agility.

Now there is no real difficulty about teaching drill and the simpler kinds of gymnastics. It is done admirably well, for example, in the North Surrey Union schools; and a year or two ago when I had an opportunity of inspecting these [390] schools, I was greatly struck with the effect of such training upon the poor little waifs and strays of humanity, mostly picked out of the gutter, who are being made into cleanly, healthy, and useful members of society in that excellent institution.

Whatever doubts people may entertain about the efficacy of natural selection, there can be none about artificial selection; and the breeder who should attempt to make, or keep up, a fine stock of pigs, or sheep, under the conditions to which the children of the poor are exposed, would be the laughing-stock even of the bucolic mind. Parliament has already done something in this direction by declining to be an accomplice in the asphyxiation of school children. It refuses to make any grant to a school in which the cubical contents of the school-room are inadequate to allow of proper respiration. I should like to see it make another step in the same direction, and either refuse to give a grant to a school in which physical training is not a part of the programme, or, at any rate, offer to pay upon such training. If something of the kind is not done, the English physique, which has been, and is still, on the whole, a grand one, will become as extinct as the dodo in the great towns.

And then the moral and intellectual effect of drill, as an introduction to, and aid of, all other sorts of training, must not be overlooked. If you want to break in a colt, surely the first thing to do is to [391]

catch him and get him quietly to face his trainer; to know his voice and bear his hand; to learn that colts have something else to do with their heels than to kick them up whenever they feel so inclined; and to discover that the dreadful human figure has no desire to devour, or even to beat him, but that, in case of attention and obedience, he may hope for patting and even a sieve of oats.

But, your "street Arabs," and other neglected poor children, are rather worse and wilder than colts; for the reason that the horse-colt has only his animal instincts in him, and his mother, the mare, has been always tender over him, and never came home drunk and kicked him in her life; while the man-colt is inspired by that very real devil, perverted manhood, and *his* mother may have done all that and more. So, on the whole, it may probably be even more expedient to begin your attempt to get at the higher nature of the child, than at that of the colt, from the physical side.

2. Next in order to physical training I put the instruction of children, and especially of girls, in the elements of household work and of domestic economy; in the first place for their own sakes, and in the second for that of their future employers.

Every one who knows anything of the life of the English poor is aware of the misery and waste caused by their want of knowledge of domestic economy, and by their lack of habits of frugality [392] and method. I suppose it is no exaggeration to say that a poor Frenchwoman would make the money which the wife of a poor Englishman spends in food go twice as far, and at the same time turn out twice as palatable a dinner. Why Englishmen, who are so notoriously fond of good living, should be so helplessly incompetent in the art of cookery, is one of the great mysteries of nature; but from the varied abominations of the railway refreshment-rooms to the monotonous dinners of the poor, English feeding is either wasteful or nasty, or both.

And as to domestic service, the groans of the housewives of England ascend to heaven! In five cases out of six the girl who takes a "place" has to be trained by her mistress in the first rudiments of decency and order; and it is a mercy if she does not turn up her nose at anything like the mention of an honest and proper economy. Thousands of young girls are said to starve, or worse, yearly in London; and at the same time thousands of mistresses of households are ready to pay high wages for a decent housemaid, or cook, or a fair workwoman; and can by no means get what they want.

Surely, if the elementary schools are worth anything, they may put an end to a state of things which is demoralising the poor, while it is wasting the lives of those better off in small worries and annoyances.

[393] 3. But the boys and girls for whose education the School Boards have to provide, have not merely to discharge domestic duties, but each of them is a member of a social and political organisation of great complexity, and has, in future life, to fit himself into that organisation, or be crushed by it. To this end it is surely needful, not only that they should be made acquainted with the elementary laws of conduct, but that their affections should be trained, so as to love with all their hearts that conduct which tends to the attainment of the highest good for themselves and their fellow men, and to hate with all their hearts that opposite course of action which is fraught with evil.

So far as the laws of conduct are determined by the intellect, I apprehend that they belong to science, and to that part of science which is called morality. But the engagement of the affections in favour of that particular kind of conduct which we call good, seems to me to be something quite beyond mere science. And I cannot but think that it, together with the awe and reverence, which have no kinship with base fear, but arise whenever one tries to pierce below the surface of things, whether they be material or spiritual, constitutes all that has any unchangeable reality in religion.

And just as I think it would be a mistake to confound the science, morality, with the affection, [394] religion; so do I conceive it to be a most lamentable and mischievous error, that the science, theology, is so confounded in the minds of many–indeed, I might say, of the majority of men.

I do not express any opinion as to whether theology is a true science, or whether it does not come under the apostolic definition of "science falsely so called;" though I may be permitted to express the belief that if the Apostle to whom that much misapplied phrase is due could make the acquaintance of much of modern theology, he would not hesitate a moment in declaring that it is exactly what he meant the words to denote.

But it is at any rate conceivable, that the nature of the Deity, and his relations to the universe, and more especially to mankind, are capable of being ascertained, either inductively or deductively, or by both processes. And, if they have been ascertained, then a body of science has been formed which is very properly called theology.

Further, there can be no doubt that affection for the Being thus defined and described by theologic science would be properly termed religion; but it would not be the whole of religion. The affection for the ethical ideal defined by moral science would claim equal if not superior rights. For suppose theology established the existence of an evil deity–and some theologies, even Christian ones, have come very near this,–[395] is the religious affection to be transferred from the ethical ideal to any such omnipotent demon? I trow not. Better a thousand times that the human race should perish under his thunderbolts than it should say, "Evil, be thou my good."

There is nothing new, that 1 know of, in this statement of the relations of religion with the science of morality on the one hand and that of theology on the other. But I believe it to be altogether true, and very needful, at this time, to be clearly and emphatically recognised as such, by those who have to deal with the education question.

We are divided into two parties–the advocates of so-called "religious" teaching on the one hand, and those of so-called "secular" teaching on the other. And both parties seem to me to be not only hopelessly wrong, but in such a position that if either succeeded completely, it would discover, before many years were over, that it had made a great mistake and done serious evil to the cause of education.

For, leaving aside the more far-seeing minority on each side, what the "religious" party is crying for is mere theology, under the name of religion; while the "secularists" have unwisely and wrongfully

admitted the assumption of their opponents, and demand the abolition of all "religious" teaching, when they only want to be free of theology–Burning your ship to get rid of the cockroaches!

[396] But my belief is, that no human being, and no society composed of human beings, ever did, or ever will, come to much, unless their conduct was governed and guided by the love of some ethical ideal. Undoubtedly, your gutter child may be converted by mere intellectual drill into "the subtlest of all the beasts of the field;" but we know what has become of the original of that description, and there is no need to increase the number of those who imitate him successfully without being aided by the rates. And if I were compelled to choose for one of my own children, between a school in which real religious instruction is given, and one without it, I should prefer the former, even though the child might have to take a good deal of theology with it. Nine-tenths of a dose of bark is mere half-rotten wood; but one swallows it for the sake of the particles of quinine, the beneficial effect of which may be weakened, but is not destroyed, by the wooden dilution, unless in a few cases of exceptionally tender stomachs.

Hence, when the great mass of the English people declare that they want to have the children in the elementary schools taught the Bible, and when it is plain from the terms of the Act, the debates in and out of Parliament, and especially the emphatic declarations of the Vice-President of the Council, that it was intended that such Bible-reading should be permitted, unless good cause [397] for prohibiting it could be shown, I do not see what reason there is for opposing that wish. Certainly, I, individually, could with no shadow of consistency oppose the teaching of the children of other people to do that which my own children are taught to do. And, even if the reading the Bible were not, as I think it is, consonant with political reason and justice, and with a desire to act in the spirit of the education measure, I am disposed to think it might still be well to read that book in the elementary schools.

I have always been strongly in favour of secular education, in the sense of education without theology; but I must confess I have been no less seriously perplexed to know by what practical measures the religious feeling, which is the essential basis of conduct, was to be kept up, in the present utterly chaotic state of opinion on these matters, without the use of the Bible. The Pagan moralists lack life and colour, and even the noble Stoic, Marcus Antonius, is too high and refined for an ordinary child. Take the Bible as a whole; make the severest deductions which fair criticism can dictate for shortcomings and positive errors; eliminate, as a sensible lay-teacher would do, if left to himself, all that it is not desirable for children to occupy themselves with; and there still remains in this old literature a vast residuum of moral beauty and grandeur. And then consider the great historical fact that, for three centuries, [398] this book has been woven into the life of all that is best and noblest in English history; that it has become the national epic of Britain, and is as familiar to noble and simple, from John-o'-Groat's House to Land's End, as Dante and Tasso once were to the Italians; that it is written in the noblest and purest English, and abounds in exquisite beauties of mere literary form; and, finally, that it forbids the veriest hind who never left his village to be ignorant of the existence of other countries and other civilisations, and of a great past, stretching back to the furthest limits of the oldest nations in the world. By the study of what other book could children be so much humanised and made to feel that each figure in that vast historical procession fills, like themselves, but a momentary space in the interval between two eternities; and earns the blessings or the curses of all time, according to its effort to do good and hate evil, even as they also are earning their payment for their work?

On the whole, then, I am in favour of reading the Bible, with such grammatical, geographical, and historical explanations by a lay-teacher as may be needful, with rigid exclusion of any further theological teaching than that contained in the Bible itself. And in stating what this is, the teacher would do well not to go beyond the precise words of the Bible; for if he does, he will, in the first place, undertake a task beyond his [399] strength, seeing that all the Jewish and Christian sects have been at work upon that subject for more than two thousand years, and have not yet arrived, and are not in the least likely to arrive, at an agreement; and, in the second place, he will certainly begin to teach something distinctively denominational, and thereby come into violent collision with the Act of Parliament.

4. The intellectual training to be given in the elementary schools must of course, in the first place, consist in learning to use the means of acquiring knowledge, or reading, writing, and arithmetic; and it will be a great matter to teach reading so completely that the act shall have become easy and pleasant. If reading remains "hard," that accomplishment will not be much resorted to for instruction, and still less for amusement–which last is one of its most valuable uses to hardworked people. But along with a due proficiency in the use of the means of learning, a certain amount of knowledge, of intellectual discipline, and of artistic training should be conveyed in the elementary schools; and in this direction–for reasons which I am afraid to repeat, having urged them so often–I can conceive no subject-matter of education so appropriate and so important as the rudiments of physical science, with drawing, modelling, and singing. Not only would such teaching afford the best possible preparation for the technical schools [400] about which so much is now said, but the organisation for carrying it into effect already exists. The Science and Art Department, the operations of which have already attained considerable magnitude, not only offers to examine and pay the results of such examination in elementary science and art, but it provides what is still more important, viz. a means of giving children of high natural ability, who are just as abundant among the poor as among the rich, a helping hand. A good old proverb tells us that "One should not take a razor to cut a block:" the razor is soon spoiled, and the block is not so well cut as it would be with a hatchet. But it is worse economy to prevent a possible Watt from being anything but a stoker, or to give a possible Faraday no chance of doing anything but to bind books. Indeed, the loss in such cases of mistaken vocation has no measure; it is absolutely infinite and irreparable. And among the arguments in favour of the interference of the State in education, none seems to be stronger than this–that it is the interest of every one that ability should be neither wasted, nor misapplied, by any one: and, therefore, that every one's representative, the State, is necessarily fulfilling the wishes of its constituents when it is helping the capacities to reach their proper places.

It may be said that the scheme of education here sketched is too large to be effected in the [401] time during which the children will remain at school; and, secondly, that even if this objection did not exist, it would cost too much.

I attach no importance whatever to the first objection until the experiment has been fairly tried. Considering how much catechism, lists of the kings of Israel, geography of Palestine, and the like, children are made to swallow now, I cannot believe there will be any difficulty in inducing them to go through the physical training, which is more than half play; or the instruction in household work, or in

those duties to one another and to themselves, which have a daily and hourly practical interest. That children take kindly to elementary science and art no one can doubt who has tried the experiment properly. And if Bible-reading is not accompanied by constraint and solemnity, as if it were a sacramental operation, I do not believe there is anything in which children take more pleasure. At least I know that some of the pleasantest recollections of my childhood are connected with the voluntary study of an ancient Bible which belonged to my grandmother. There were splendid pictures in it, to be sure; but I recollect little or nothing about them save a portrait of the high priest in his vestments. What come vividly back on my mind are remembrances of my delight in the histories of Joseph and of David; and of my keen appreciation of the chivalrous kindness of Abraham in his dealing [402] with Lot. Like a sudden flash there returns back upon me, my utter scorn of the pettifogging meanness of Jacob, and my sympathetic grief over the heartbreaking lamentation of the cheated Esau, "Hast thou not a blessing for me also, O my father?" And I see, as in a cloud, pictures of the grand phantasmagoria of the Book of Revelation.

I enumerate, as they issue, the childish impressions which come crowding out of the pigeon-holes in my brain, in which they have lain almost undisturbed for forty years. I prize them as an evidence that a child of five or six years old, left to his own devices, may be deeply interested in the Bible, and draw sound moral sustenance from it. And I rejoice that I was left to deal with the Bible alone; for if I had had some theological "explainer" at my side, he might have tried, as such do, to lessen my indignation against Jacob, and thereby have warped my moral sense for ever; while the great apocalyptic spectacle of the ultimate triumph of right and justice might have been turned to the base purposes of a pious lampooner of the Papacy.

And as to the second objection–costliness–the reply is, first, that the rate and the Parliamentary grant together ought to be enough, considering that science and art teaching is already provided for; and, secondly, that if they are not, it may be well for the educational parliament to [403] consider what has become of those endowments which were originally intended to be devoted, more or less largely, to the education of the poor.

When the monasteries were spoiled, some of their endowments were applied to the foundation of cathedrals; and in all such cases it was ordered that a certain portion of the endowment should be applied to the purposes of education. How much is so applied? Is that which may be so applied given to help the poor, who cannot pay for education, or does it virtually subsidise the comparatively rich, who can? How are Christ's Hospital and Alleyn's foundation securing their right purposes, or how far are they perverted into contrivances for affording relief to the classes who can afford to pay for education? How–But this paper is already too long, and, if I begin, I may find it hard to stop asking questions of this kind, which after all are worthy only of the lowest of Radicals.

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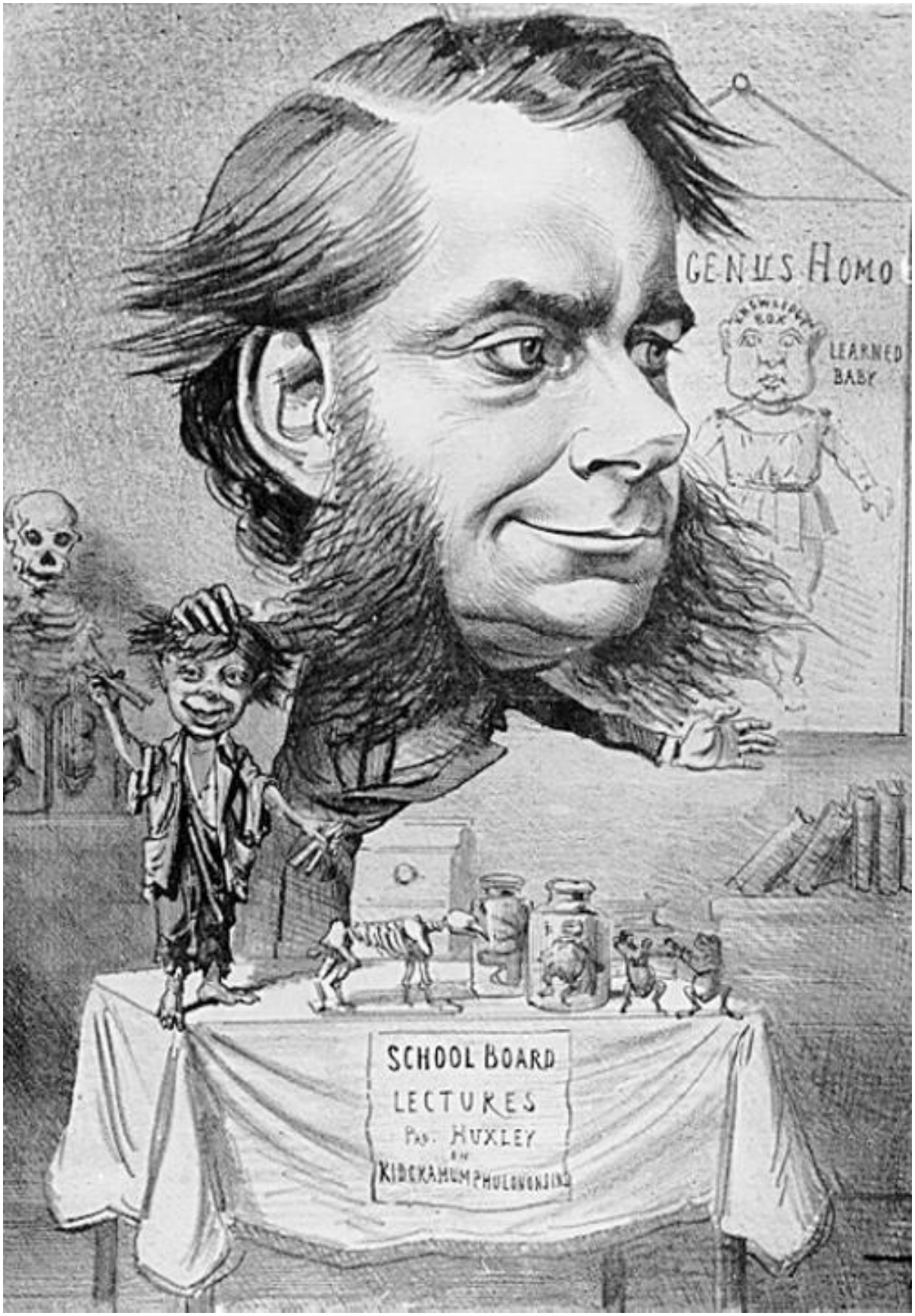
[1] Notwithstanding Mr. Huxley's intentions, the Editor took upon himself, in what seemed to him to be the public interest, to send an extract from this article to the newspapers–before the day of the election of the School Board.–Editor of the *Contemporary Review*.

[2] A passage in an article on the "Working of the Education Act," in the *Saturday Review* for Nov. 19, 1870, completely justifies this anticipation of the line of action which the sectaries mean to take. After commending the Liverpool compromise, the writer goes on to say:–

"If this plan is fairly adopted in Liverpool, the fourteenth clause of the Act will in effect be restored to its original form, and the majority of the ratepayers in each district be permitted to decide to what denomination the school shall belong."

In a previous paragraph the writer speaks of a possible "mistrust" of one another by the members of the Board, and seems to anticipate "accusations of dishonesty." If any of the members of the Board adopt his views, I think it highly probable that he may turn out to be a true prophet.

[3] Since this paragraph was written, Mr. Forster, in speaking at the Birkbeck Institution, has removed all doubt as to what his "final decision" will be in the case of such disputes being referred to him:–"I have the fullest confidence that in the reading and explaining of the Bible, what the children will be taught will be the great truths of Christian life and conduct, which all of us desire they should know, and that no effort will be made to cram into their poor little minds, theological dogmas which their tender age prevents them from understanding."

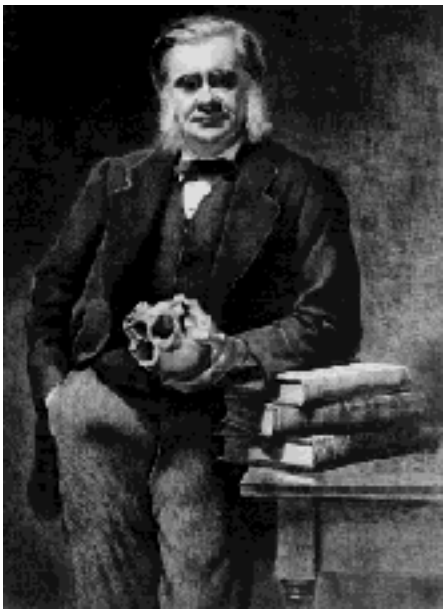


"Huxley on Mountin' Kids"

Hornet 1871

"Having anatomically gauged the capabilities of the knowledge-box to spell 'pap' fluently, and at the age of seven embark in surgery, music, and the study of natural phenomena, including, of course, itself."

THE HUXLEY FILE



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Next article: Technical Education [1877], pages 404-426.

Previous article: The Connection of the Biological Sciences with Medicine [1881], pages 347-373.

C. Blinderman & D. Joyce
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Joseph Priestley
(*Macmillan's Magazine* 1874)

Collected Essays III

[1] If the man to perpetuate whose memory we have this day raised a statue had been asked on what part of his busy life's work he set the highest value, he would undoubtedly have pointed to his voluminous contributions to theology. In season and out of season, he was the steadfast champion of that hypothesis respecting the Divine nature which is termed Unitarianism by its friends and Socinianism by its foes. Regardless of odds, he was ready to do battle with all comers in that cause; and if no adversaries entered the lists, he would sally forth to seek them.

To this, his highest ideal of duty, Joseph Priestley sacrificed the vulgar prizes of life, which, assuredly, were within easy reach of a man of his singular energy and varied abilities. For this object he put aside, as of secondary importance, those scientific investigations which he loved so [2] well, and in which he showed himself so competent to enlarge the boundaries of natural knowledge and to win fame. In this cause he not only cheerfully suffered obloquy from the bigoted and the unthinking, and came within sight of martyrdom; but bore with that which is much harder to be borne than all these, the unfeigned astonishment and hardly disguised contempt of a brilliant society, composed of men whose sympathy and esteem must have been most dear to him, and to whom it was simply incomprehensible that a philosopher should seriously occupy himself with any form of Christianity.

It appears to me that the man who, setting before himself such an ideal of life, acted up to it consistently, is worthy of the deepest respect, whatever opinion may be entertained as to the real value of the tenets which he so zealously propagated and defended,

But I am sure that I speak not only for myself, but for all this assemblage, when I say that our purpose to-day is to do honour, not to Priestley, the Unitarian divine, but to Priestley, the fearless defender of rational freedom in thought and in action: to Priestley, the philosophic thinker; to that Priestley who held a foremost place among "the swift runners who hand over the lamp of life,"[1] and transmit from one generation to another [3] the fire kindled, in the childhood of the world, at the Promethean altar of Science.

The main incidents of Priestley's life are so well known that I need dwell upon them at no great length.

Born in 1733, at Fieldhead, near Leeds, and brought up among Calvinists of the straitest orthodoxy, the boy's striking natural ability led to his being devoted to the profession of a minister of religion; and, in 1752, he was sent to the Dissenting Academy at Daventry–an institution which authority left undisturbed, though its existence contravened the law. The teachers under whose instruction and influence the young man came at Daventry, carried out to the letter the injunction to "try all things: hold

fast that which is good," and encouraged the discussion of every imaginable proposition with complete freedom, the leading professors taking opposite sides; a discipline which, admirable as it may be from a purely scientific point of view, would seem to be calculated to make acute, rather than sound, divines. Priestley tells us, in his "Autobiography," that he generally found himself on the unorthodox side: and, as he grew older, and his faculties attained their maturity, this native tendency towards heterodoxy grew with his growth and strengthened with his strength. He passed from Calvinism to Arianism; and finally, in middle life, [4] landed in that very broad form of Unitarianism by which his craving after a credible and consistent theory of things was satisfied.

On leaving Daventry Priestley became minister of a Congregation, first at Needham Market, and secondly at Nantwich; but whether on account of his heterodox opinions, or of the stuttering which impeded his expression of them in the pulpit, little success attended his efforts in this capacity. In 1761, a career much more suited to his abilities became open to him. He was appointed "tutor in the languages" in the Dissenting Academy at Warrington, in which capacity, besides giving three courses of lectures, he taught Latin, Greek, French, and Italian, and read lectures on the theory of language and universal grammar, on oratory, philosophical criticism, and civil law. And it is interesting to observe that, as a teacher, he encouraged and cherished in those whom he instructed the freedom which he had enjoyed, in his own student days, at Daventry. One of his pupils tells us that,

"At the conclusion of his lecture, he always encouraged his students to express their sentiments relative to the subject of it, and to urge any objections to what he had delivered, without reserve. It pleased him when any one commenced such a conversation. In order to excite the freest discussion, he occasionally invited the students to drink tea with him, in order to canvass the subjects of his lectures. I do not recollect that he ever showed the least displeasure at the strongest objections that were made to what he delivered, but I distinctly remember the [5] smile of approbation with which he usually received them: nor did he fail to point out, in a very encouraging manner, the ingenuity or force of any remarks that were made, when they merited these characters. His object, as well as Dr. Aikin's, was to engage the students to examine and decide for themselves, uninfluenced by the sentiments of any other persons."[2]

It would be difficult to give a better description of a model teacher than that conveyed in these words.

From his earliest days, Priestley had shown a strong bent towards the study of nature; and his brother Timothy tells us that the boy put spiders into bottles, to see how long they would live in the same air–a curious anticipation of the investigations of his later years. At Nantwich, where he set up a school, Priestley informs us that he bought an air pump, an electrical machine, and other instruments, in the use of which he instructed his scholars. But he does not seem to have devoted himself seriously to physical science until 1766, when he had the great good fortune to meet Benjamin Franklin, whose friendship he ever afterwards enjoyed. Encouraged by Franklin, he wrote a "History of Electricity," which was published in 1767, and appears to have met with considerable success.

In the same year, Priestley left Warrington to become the minister of a congregation at Leeds; [6] and, here, happening to live next door to a public brewery, as he says,

"I, at first, amused myself with making experiments on the fixed air which I found ready-made in the process of fermentation. When I removed from that house I was under the necessity of making fixed air for myself; and one experiment leading to another, as I have distinctly and faithfully noted in my various publications on the subject, I by degrees contrived a convenient apparatus for the purpose, but of the cheapest kind.

"When I began these experiments I knew very little of *chemistry,* and had, in a manner, no idea on the subject before I attended a course of chemical lectures, delivered in the Academy at Warrington, by Dr. Turner of Liverpool. But I have often thought that, upon the whole, this circumstance was no disadvantage to me; as, in this situation, I was led to devise an apparatus and processes of my own, adapted to my peculiar views; whereas, if I had been previously accustomed to the usual chemical processes, I should not have so easily thought of any other, and without new modes of operation, I should hardly have discovered anything materially new."[3]

The first outcome of Priestley's chemical work, published in 1772, was of a very practical character. He discovered the way of impregnating water with an excess of "fixed air," or carbonic acid, and thereby producing what we now know as "soda water"–a service to naturally, and still more to artificially, thirsty souls, which those whose parched throats and hot heads are cooled by morning draughts of that beverage, cannot too gratefully acknowledge. In the same year, Priestley communicated the extensive series of [7] observations which his industry and ingenuity had accumulated, in the course of four years, to the Royal Society, under the title of "Observations on Different Kinds of Air"–a memoir which was justly regarded of so much merit and importance, that the Society at once conferred upon the author the highest distinction in their power, by awarding him the Copley Medal.

In 1771 a proposal was made to Priestley to accompany Captain Cook in his second voyage to the South Seas. He accepted it, and his congregation agreed to pay an assistant to supply his place during his absence. But the appointment lay in the hands of the Board of Longitude, of which certain clergymen were members; and whether these worthy ecclesiastics feared that Priestley's presence among the ship's company might expose His Majesty's sloop *Resolution* to the fate which aforetime befell a certain ship that went from Joppa to Tarshish; or whether they were alarmed lest a Socinian should undermine that piety which, in the days of Commodore Trunnion, so strikingly characterised sailors, does not appear; but, at any rate, they objected to Priestley "on account of his religious principles," and appointed the two Forsters, whose "religious principles," if they had been known to these well-meaning but not far-sighted persons, would probably have surprised them.

In 1772 another proposal was made to Priestley. [8] Lord Shelburne, desiring a "literary companion," had been brought into communication with Priestley by the good offices of a friend of both, Dr. Price; and offered him the nominal post of librarian, with a good house and appointments, and an annuity in case of the termination of the engagement. Priestley accepted the offer, and remained with Lord Shelburne for seven years, sometimes residing at Calne, sometimes travelling abroad with the Earl.

Why the connection terminated has never been exactly known; but it is certain that Lord Shelburne behaved with the utmost consideration and kindness towards Priestley; that he fulfilled his engagements to the letter; and that, at a later period, he expressed a desire that Priestley should return to his old footing in his house. Probably enough, the politician, aspiring to the highest offices in the State, may

have found the position of the protector of a man who was being denounced all over the country as an infidel and an atheist somewhat embarrassing. In fact, a passage in Priestley's "Autobiography" on the occasion of the publication of his "Disquisitions relating to Matter and Spirit," which took place in 1777, indicates pretty clearly the state of the case:–

"(126) It being probable that this publication would be unpopular, and might be the means of bringing odium on my patron, several attempts were made by his friends, though none [9] by himself, to dissuade me from persisting in it. But being, as I thought, engaged in the cause of important truth, I proceeded without regard to any consequences, assuring them that this publication should not be injurious to his lordship."

It is not unreasonable to suppose that his lordship, as a keen, practical man of the world, did not derive much satisfaction from this assurance. The "evident marks of dissatisfaction" which Priestley says he first perceived in his patron in 1778, may well have arisen from the peer's not unnatural uneasiness as to what his domesticated, but not tamed, philosopher might write next, and what storm might thereby be brought down on his own head; and it speaks very highly for Lord Shelburne's delicacy that, in the midst of such perplexities, he made not the least attempt to interfere with Priestley's freedom of action. In 1780, however, he intimated to Dr. Price that he should be glad to establish Priestley on his Irish estates: the suggestion was interpreted, as Lord Shelburne probably intended it should be, and Priestley left him, the annuity of £150 a year, which had been promised in view of such a contingency, being punctually paid.

After leaving Calne, Priestley spent some little time in London, and then, having settled in Birmingham at the desire of his brother-in-law, he was soon invited to become the minister of a large congregation. This settlement Priestley considered, at the time, to be "the happiest event of [10] his life." And well he might think so; for it gave him competence and leisure; placed him within reach of the best makers of apparatus of the day; made him a member of that remarkable "Lunar Society," at whose meetings he could exchange thoughts with such men as Watt, Wedgwood, Darwin, and Boulton; and threw open to him the pleasant house of the Galtons of Barr, where these men, and others of less note, formed a society of exceptional charm and intelligence.[4]

But these halcyon days were ended by a bitter storm. The French Revolution broke out. An electric shock ran through the nations; whatever there was of corrupt and retrograde, and, at the same time, a great deal of what there was of best and noblest, in European society shuddered at [11] the outburst of long-pent-up social fires. Men's feelings were excited in a way that we, in this generation, can hardly comprehend. Party wrath and virulence were expressed in a manner unparalleled, and it is to be hoped impossible, in our times; and Priestley and his friends were held up to public scorn, even in Parliament, as fomenters of sedition. A "Church-and-King" cry was raised against the Liberal Dissenters; and, in Birmingham, it was intensified and specially directed towards Priestley by a local controversy, in which he had engaged with his usual vigour. In 1791, the celebration of the second anniversary of the taking of the Bastille by a public dinner, with which Priestley had nothing whatever to do, gave the signal to the loyal and pious mob, who, unchecked, and indeed to some extent encouraged, by those who were responsible for order, had the town at their mercy for three days. The chapels and houses of the leading Dissenters were wrecked, and Priestley and his family had to fly for their lives, leaving library,

apparatus, papers, and all their possessions, a prey to the flames.

Priestley never returned to Birmingham. He bore the outrages and losses inflicted upon him with extreme patience and sweetness,[5] and betook [12] himself to London. But even his scientific colleagues gave him a cold shoulder; and though he was elected minister of a congregation at Hackney, he felt his position to be insecure, and finally determined on emigrating to the United States. He landed in America in 1794; lived quietly with his sons at Northumberland, in Pennsylvania, where his posterity still flourish; and, clear-headed and busy to the last, died on the 6th of February 1804.

Such were the conditions under which Joseph Priestley did the work which lay before him, and then, as the Norse Sagas say, went out of the story. The work itself was of the most varied kind. No human interest was without its attraction for Priestley, and few men have ever had so many irons in the fire at once; but, though he may have burned his fingers a little, very few who have tried that operation have burned their fingers so little. He made admirable discoveries in science; his philosophical treatises are still well worth reading; his political works are full of insight and replete with the spirit of freedom; and while all these sparks flew off from his anvil, the controversial hammer rained a hail of blows on orthodox priest and bishop. While thus engaged, the kindly, cheerful doctor felt no more wrath or uncharitableness towards his opponents than a smith does towards his iron. But if the iron [13] could only speak!–and the priests and bishops took the point of view of the iron.

No doubt what Priestley's friends repeatedly urged upon him–that he would have escaped the heavier trials of his life and done more for the advancement of knowledge, if he had confined himself to his scientific pursuits and let his fellowmen go their way–was true. But it seems to have been Priestley's feeling that he was a man and a citizen before he was a philosopher, and that the duties of the two former positions are at least as imperative as those of the latter. Moreover, there are men (and I think Priestley was one of them) to whom the satisfaction of throwing down a triumphant fallacy is as great as that which attends the discovery of a new truth; who feel better satisfied with the government of the world, when they have been helping Providence by knocking an imposture on the head; and who care even more for freedom of thought than for mere advance of knowledge. These men are the Carnots who organise victory for truth, and they are, at least, as important as the generals who visibly fight her battles in the field.

Priestley's reputation as a man of science rests upon his numerous and important contributions to the chemistry of gaseous bodies; and to form a just estimate of the value of his work–of the extent to which it advanced the knowledge of [4] fact and the development of sound theoretical views–we must reflect what chemistry was in the first half of the eighteenth century.

The vast science which now passes under that name had no existence. Air, water, and fire were still counted among the elemental bodies; and though Van Helmont, a century before, had distinguished different kinds of air as *gas ventosum* and *gas sylvestre*, and Boyle and Hales had experimentally defined the physical properties of air and discriminated some of the various kinds of aëriform bodies, no one suspected the existence of the numerous totally distinct gaseous elements which are now known, or

dreamed that the air we breathe and the water we drink are compounds of gaseous elements.

But, in 1754, a young Scotch physician, Dr. Black, made the first clearing in this tangled backwood of knowledge. And it gives one a wonderful impression of the juvenility of scientific chemistry to think that Lord Brougham, whom so many of us recollect, attended Black's lectures when he was a student in Edinburgh. Black's researches gave the world the novel and startling conception of a gas that was a permanently elastic fluid like air, but that differed from common air in being much heavier, very poisonous, and in having the properties of an acid, capable of neutralising the strongest alkalies; and it took the world some time to become accustomed to the notion.

[15] A dozen years later, one of the most sagacious and accurate investigators who has adorned this, or any other, country, Henry Cavendish, published a memoir in the "Philosophical Transactions," in which he deals not only with the "fixed air" (now called carbonic acid or carbonic anhydride) of Black, but with "inflammable air," or what we now term hydrogen.

By the rigorous application of weight and measure to all his processes, Cavendish implied the belief subsequently formulated by Lavoisier, that, in chemical processes, matter is neither created nor destroyed, and indicated the path along which all future explorers must travel. Nor did he himself halt until this path led him, in 1784, to the brilliant and fundamental discovery that water is composed of two gases united in fixed and constant proportions.

It is a trying ordeal for any man to be compared with Black and Cavendish, and Priestley cannot be said to stand on their level. Nevertheless his achievements are not only great in themselves, but truly wonderful, if we consider the disadvantages under which he laboured. Without the careful scientific training of Black, without the leisure and appliances secured by the wealth of Cavendish, he scaled the walls of science as so many Englishmen have done before and since his day; and trusting to mother wit to supply the place of training, and to ingenuity to create apparatus out of washing [16] tubs, he discovered more new gases than all his predecessors put together had done. He laid the foundations of gas analysis; he discovered the complementary actions of animal and vegetable life upon the constituents of the atmosphere; and, finally, he crowned his work, this day one hundred years ago, by the discovery of that "pure dephlogisticated air" to which the French chemists subsequently gave the name of oxygen. Its importance, as the constituent of the atmosphere which disappears in the processes of respiration and combustion, and is restored by green plants growing in sunshine, was proved somewhat later. For these brilliant discoveries, the Royal Society elected Priestley a fellow and gave him their medal, while the Academies of Paris and St. Petersburg conferred their membership upon him. Edinburgh had made him an honorary doctor of laws at an early period of his career; but, I need hardly add that a man of Priestley's opinions received no recognition from the universities of his own country.

That Priestley's contributions to the knowledge of chemical fact were of the greatest importance, and that they richly deserve all the praise that has been awarded to them, is unquestionable; but it must, at the same time, be admitted that he had no comprehension of the deeper significance of his work; and, so far from contributing anything to the theory of the facts which he discovered, or [17] assisting in their

rational explanation, his influence to the end of his life was warmly exerted in favour of error. From first to last, he was a stiff adherent of the phlogiston doctrine which was prevalent when his studies commenced; and, by a curious irony of fate, the man who by the discovery of what he called "dephlogisticated air" furnished the essential datum for the true theory of combustion, of respiration, and of the composition of water, to the end of his days fought against the inevitable corollaries from his own labours. His last scientific work, published in 1800, bears the title, "The Doctrine of Phlogiston established, and that of the Composition of Water refuted."

When Priestley commenced his studies, the current belief was, that atmospheric air, freed from accidental impurities, is a simple elementary substance, indestructible and unalterable, as water was supposed to be. When a combustible burned, or when an animal breathed in air, it was supposed that a substance, "phlogiston," the matter of heat and light, passed from the burning or breathing body into it, and destroyed its powers of supporting life and combustion. Thus, air contained in a vessel in which a lighted candle had gone out, or a living animal had breathed until it could breathe no longer, was called "phlogisticated." The same result was supposed to be brought about by the addition of what Priestley called "nitrous gas" to common air.

[18] In the course of his researches, Priestley found that the quantity of common air which can thus become "phlogisticated," amounts to about one-fifth the volume of the whole quantity submitted to experiment. Hence it appeared that common air consists, to the extent of four-fifths of its volume, of air which is already "phlogisticated"; while the other fifth is free from phlogiston, or "dephlogisticated." On the other hand, Priestley found that air "phlogisticated" by combustion or respiration could be "dephlogisticated," or have the properties of pure common air restored to it, by the action of green plants in sunshine. The question, therefore, would naturally arise–as common air can be wholly phlogisticated by combustion, and converted into a substance which will no longer support combustion, is it possible to get air that shall be less phlogisticated than common air, and consequently support combustion better than common air does?

Now, Priestley says that, in 1774, the possibility of obtaining air less phlogisticated than common air had not occurred to him.[6] But in pursuing his experiments on the evolution of air from various bodies by means of heat, it happened that, on the 1st of August 1774, he threw the heat of the sun, by means of a large burning glass which he had recently obtained, upon a substance [19] which was then called *mercurius calcinatus per se,* and which is commonly known as red precipitate.

"I presently found that, by means of this lens, air was expelled from it very readily. Having got about three or four times as much as the bulk of my materials, I admitted water to it, and found that it was not imbibed by it. But what surprised me more than I can well express, was that a candle burned in this air with a remarkably vigorous flame, very much like that enlarged flame with which a candle burns in nitrous air, exposed to iron or lime of sulphur; but as I had got nothing like this remarkable appearance from any kind of air besides this particular modification of nitrous air, and I knew no nitrous acid was used in the preparation of *mercurius calcinatus,* I was utterly at a loss how to account for it.

"In this case also, though I did not give sufficient attention to the circumstance at that time, the flame of the

candle, besides being larger, burned with more splendour and heat than in that species of nitrous air; and a piece of red-hot wood sparkled in it, exactly like paper dipped in a solution of nitre, and it consumed very fast–an experiment which I had never thought of trying with nitrous air."[7]

Priestley obtained the same sort of air from red lead, but, as he says himself, he remained in ignorance of the properties of this new kind of air for seven months, or until March 1775, when he found that the new air behaved with "nitrous gas" in the same way as the dephlogisticated part of common air does;[8] but that, instead of being diminished to four-fifths, it almost completely vanished, and, therefore, showed itself to be "between five and six times as good as the best [20] common air I have ever met with."[9] As this new air thus appeared to be completely free from phlogiston, Priestley called it "dephlogisticated air."

What was the nature of this air? Priestley found that the same kind of air was to be obtained by moistening with the spirit of nitre (which he terms nitrous acid) any kind of earth that is free from phlogiston, and applying heat; and consequently he says: "There remained no doubt on my mind but that the atmospherical air, or the thing that we breathe, consists of the nitrous acid and earth, with so much phlogiston as is necessary to its elasticity, and likewise so much more as is required to bring it from its state of perfect purity to the mean condition in which we find it."[10]

Priestley's view, in fact, is that atmospheric air is a kind of saltpetre, in which the potash is replaced by some unknown earth. And in speculating on the manner in which saltpetre is formed, he enunciates the hypothesis, "that nitre is formed by a real *decomposition of the air itself,* the *bases* that are presented to it having, in such circumstances, a nearer affinity with the spirit of nitre than that kind of earth with which it is united in the atmosphere."[11]

[21] It would have been hard for the most ingenious person to have wandered farther from the truth than Priestley does in this hypothesis; and, though Lavoisier undoubtedly treated Priestley very ill, and pretended to have discovered dephlogisticated air, or oxygen, as he called it, independently, we can almost forgive him when we reflect how different were the ideas which the great French chemist attached to the body which Priestley discovered.

They are like two navigators of whom the first sees a new country, but takes clouds for mountains and mirage for lowlands; while the second determines its length and breadth, and lays down on a chart its exact place, so that, thenceforth, it serves as a guide to his successors, and becomes a secure outpost whence new explorations may be pushed.

Nevertheless, as Priestley himself somewhere remarks, the first object of physical science is to ascertain facts, and the service which he rendered to chemistry by the definite establishment of a large number of new and fundamentally important facts, is such as to entitle him to a very high place among the fathers of chemical science.

It is difficult to say whether Priestley's philosophical, political, or theological views were most responsible for the bitter hatred which was borne to him by a large body of his country[22]men,[12] and which found its expression in the malignant insinuations in which Burke, to his everlasting shame, indulged in the House of Commons.

Without containing much that will be new to the readers of Hobbs, Spinoza, Collins, Hume, and Hartley, and, indeed, while making no pretensions to originality, Priestley's "Disquisitions relating to Matter and Spirit," and his "Doctrine of Philosophical Necessity Illustrated," are among the most powerful, clear, and unflinching expositions of materialism and necessarianism which exist in the English language, and are still well worth reading.

Priestley denied the freedom of the will in the sense of its self-determination; he denied the existence of a soul distinct from the body; and as a natural consequence, he denied the natural immortality of man.

In relation to these matters English opinion, a century ago, was very much what it is now.

[23] A man may be a necessarian without incurring graver reproach than that implied in being called a gloomy fanatic, necessarianism, though very shocking, having a note of Calvinistic orthodoxy; but, if a man is a materialist; or, if good authorities say he is and must be so, in spite of his assertion to the contrary; or, if he acknowledge himself unable to see good reasons for believing in the natural immortality of man, respectable folks look upon him as an unsafe neighbour of a cashbox, as an actual or potential sensualist, the more virtuous in outward seeming, the more certainly loaded with secret "grave personal sins."

Nevertheless, it is as certain as anything can be, that Joseph Priestley was no gloomy fanatic, but as cheerful and kindly a soul as ever breathed, the idol of children; a man who was hated only by those who did not know him, and who charmed away the bitterest prejudices in personal intercourse; a man who never lost a friend, and the best testimony to whose worth is the generous and tender warmth with which his many friends vied with one another in rendering him substantial help, in all the crises of his career.

The unspotted purity of Priestley's life, the strictness of his performance of every duty, his transparent sincerity, the unostentatious and deep-seated piety which breathes through all his correspondence, are in themselves a sufficient refutation of the hypothesis, invented by bigots to cover [24] uncharitableness, that such opinions as his must arise from moral defects. And his statue will do as good service as the brazen image that was set upon a pole before the Israelites, if those who have been bitten by the fiery serpents of sectarian hatred, which still haunt this wilderness of a world, are made whole by looking upon the image of a heretic who was yet a saint.

Though Priestley did not believe in the natural immortality of man, he held with an almost naive realism that man would be raised from the dead by a direct exertion of the power of God, and thenceforward be immortal. And it may be as well for those who may be shocked by this doctrine to know that views, substantially identical with Priestley's, have been advocated, since his time, by two prelates of the

Anglican Church: by Dr. Whately, Archbishop of Dublin, in his well-known "Essays";[13] and by Dr. Courtenay, Bishop of Kingston in Jamaica, the first edition of whose remarkable book "On the Future States," dedicated to Archbishop Whately, was published in 1843 and the second in 1807. According to Bishop Courtenay,

"The death of the body will cause a cessation of all the activity of the mind by way of natural consequence; to continue for ever unless the Creator should interfere."

[25] And again:–

"The natural end of human existence is the 'first death,' the dreamless slumber of the grave, wherein man lies spellbound, soul and body, under the dominion of sin and death–that whatever modes of conscious existence, whatever future states of 'life' or of 'torment' beyond Hades are reserved for man, are results of our blessed Lord's victory over sin and death; that the resurrection of the dead must be preliminary to their entrance into either of the future states, and that the nature and even existence of these states, and even the mere fact that there is a futurity of consciousness, can be known *only* through God's revelation of Himself in the Person and the Gospel of His Son."–P. 389.

And now hear Priestley:–

"Man, according to this system (of materialism), is no more than we now see of him. His being commences at the time of his conception, or perhaps at an earlier period. The corporeal and mental faculties, in being in the same substance, grow, ripen, and decay together; and whenever the system is dissolved it continues in a state of dissolution till it shall please that Almighty Being who called it into existence to restore it to life again "–" Matter and Spirit," p. 49.

And again:–

"The doctrine of the Scripture is, that God made man of the dust of the ground, and by simply animating this organised matter, made man that living percipient and intelligent being that he is. According to Revelation, *death* is a state of rest and insensibility, and our only though sure hope of a future life is founded on the doctrine of the resurrection of the whole man at some distant period; this assurance being sufficiently confirmed to us both by the evident tokens of a Divine commission attending the persons who delivered the doctrine, and especially by the actual resurrection of Jesus Christ, which is more authentically attested than any other fact in history."–*Ibid.*, p. 247.

[26] We all know that "a saint in crape is twice a saint in lawn;" but it is not yet admitted that the views which are consistent with such saintliness in lawn, become diabolical when held by a mere dissenter.[14]

I am not here either to defend or to attack Priestley's philosophical views, and I cannot say that I am personally disposed to attach much value to episcopal authority in philosophical questions; but it seems right to call attention to the fact, that those of Priestley's opinions which have brought most odium upon him have been openly promulgated, without challenge, by persons occupying the highest positions in the

State Church.

I must confess that what interests me most about Priestley's materialism, is the evidence that he saw dimly the seed of destruction which such materialism carries within its own bosom. In the course of his reading for his "History of Discoveries relating to Vision, Light, and Colours," he had come upon the speculations of Boscovich [27] and Michell, and had been led to admit the sufficiently obvious truth that our knowledge of matter is a knowledge of its properties; and that of its substance–if it have a substance–we know nothing. And this led to the further admission that, so far as we can know, there may be no difference between the substance of matter and the substance of spirit ("Disquisitions," p. 16). A step farther would have shown Priestley that his materialism was, essentially, very little different from the Idealism of his contemporary, the Bishop of Cloyne.

As Priestley's philosophy is mainly a clear statement of the views of the deeper thinkers of his day, so are his political conceptions based upon those of Locke. Locke's aphorism that "the end of government is the good of mankind," is thus expanded by Priestley:–

"It must necessarily be understood, therefore, whether it be expressed or not, that all people live in society for their mutual advantage, so that the good and happiness of the members, that is, of the majority of the members, of any state, is the great standard by which everything relating to that state must finally be determined."[15]

The little sentence here interpolated, "that is, of the majority of the members of any state," appears to be that passage which suggested to Bentham, according to his own acknowledgment, the famous "greatest happiness" formula, which [28] by substituting "happiness" for "good," has converted a noble into an ignoble principle. But I do not call to mind that there is any utterance in Locke quite so outspoken as the following passage in the "Essay on the First Principles of Government." After laying down as "a fundamental maxim in all Governments," the proposition that "kings, senators, and nobles" are "the servants of the public," Priestley goes on to say:–

"But in the largest states, if the abuses of the government should at any time be great and manifest; if the servants of the people, forgetting their masters and their masters' interest should pursue a separate one of their own; if, instead of considering that they are made for the people, they should consider the people as made for them; if the oppressions and violation of right should be great, flagrant, and universally resented; if the tyrannical governors should have no friends but a few sycophants, who had long preyed upon the vitals of their fellow-citizens, and who might be expected to desert a government whenever their interests should be detached from it: if, in consequence of these circumstances, it should become manifest that the risk which would be run in attempting a revolution would be trifling, and the evils which might be apprehended from it were far less than those which were actually suffered and which were daily increasing; in the name of God, I ask what principles are those which ought to restrain an injured and insulted people from asserting their natural rights, and from changing or even punishing their governors–that is, their servants–who had abused their trust, or from altering the whole form of their government, if it appeared to be of a structure so liable to abuse?"

As a Dissenter, subject to the operation of the Corporation and Test Acts, and as a Unitarian excluded from the benefit of the Toleration Act, [29] it is not surprising to find that Priestley had very definite

opinions about Ecclesiastical Establishments; the only wonder is that these opinions were so moderate as the following passages show them to have been:–

"Ecclesiastical authority may have been necessary in the infant state of society, and, for the same reason, it may perhaps continue to be, in some degree, necessary as long as society is imperfect; and therefore may not be entirely abolished till civil governments have arrived at a much greater degree of perfection. If, therefore, I were asked whether I should approve of the immediate dissolution of all the ecclesiastical establishments in Europe, I should answer, No.... Let experiment be first made of *alterations*, or, which is the same thing, of *better establishments* than the present. Let them be reformed in many essential articles, and then not thrown aside entirely till it be found by experience that no good can be made of them."

Priestley goes on to suggest four such reforms of a capital nature:–

"1. Let the Articles of Faith to be subscribed by candidates for the ministry be greatly reduced. In the formulary of the Church of England, might not thirty-eight out of the thirty-nine be very well spared? It is a reproach to any Christian establishment if every man cannot claim the benefit of it who can say that he believes in the religion of Jesus Christ as it is set forth in the New Testament. You say the terms are so general that even Deists would quibble and insinuate themselves. I answer that all the articles which are subscribed at present by no means exclude Deists who will prevaricate; and upon this scheme you would at least exclude fewer honest men."[16]

[30] The second reform suggested is the equalisation, in proportion to work done, of the stipends of the clergy; the third, the exclusion of the Bishops from Parliament; and the fourth, complete toleration, so that every man may enjoy the rights of a citizen, and be qualified to serve his country, whether he belong to the Established Church or not.

Opinions such as those I have quoted, respecting the duties and the responsibilities of governors, are the commonplaces of modern Liberalism; and Priestley's views on Ecclesiastical Establishments would, I fear, meet with but a cool reception, as altogether too conservative, from a large proportion of the lineal descendants of the people who taught their children to cry "Damn Priestley;" and with that love for the practical application of science which is the source of the greatness of Birmingham, tried to set fire to the doctor's house with sparks from his own electrical machine; thereby giving the man they called an incendiary and raiser of sedition against Church and King, an appropriately experimental illustration of the nature of arson and riot.

If I have succeeded in putting before you the main features of Priestley's work, its value will become apparent when we compare the condition of the English nation, as he knew it, with its present state.

[31] The fact that France has been for eighty-five years trying, without much success, to right herself after the great storm of the Revolution, is not unfrequently cited among us as an indication of some inherent incapacity for self-government among the French people. I think, however, that Englishmen who argue thus, forget that, from the meeting of the Long Parliament in 1640, to the last Stuart rebellion in 1745, is a hundred and five years, and that, in the middle of the last century, we had but just safely freed ourselves from our Bourbons and all that they represented. The corruption of our state was as bad

as that of the Second Empire. Bribery was the instrument of government, and peculation its reward. Four-fifths of the seats in the House of Commons were more or less openly dealt with as property. A minister had to consider the state of the vote market, and the sovereign secured a sufficiency of "king's friends" by payments allotted with retail, rather than royal, sagacity.

Barefaced and brutal immorality and intemperance pervaded the land, from the highest to the lowest classes of society. The Established Church was torpid, as far as it was not a scandal; but those who dissented from it came within the meshes of the Act of Uniformity, the Test Act, and the Corporation Act. By law, such a man as Priestley, being a Unitarian, could neither teach nor preach, and was liable to ruinous fines and [32] long imprisonment.[17] In those days the guns that were pointed by the Church against the Dissenters were shotted. The law was a cesspool of iniquity and cruelty. Adam Smith was a new prophet whom few regarded, and commerce was hampered by idiotic impediments, and ruined by still more absurd help, on the part of government.

Birmingham, though already the centre of a considerable industry, was a mere village as compared with its present extent. People who travelled went about armed, by reason of the abundance of highwaymen and the paucity and inefficiency of the police. Stage coaches had not reached Birmingham, and it took three days to get to London. Even canals were a recent and much opposed invention.

Newton had laid the foundation of a mechanical conception of the physical universe: Hartley, putting a modern face upon ancient materialism, had extended that mechanical conception to psychology; Linnæus and Haller were beginning to introduce method and order into the chaotic accumulation of biological facts. But those parts of physical science which deal with heat, electricity, and magnetism, and above all, chemistry, in the modern sense, can hardly be said to have had an existence. No one [33] knew that two of the old elemental bodies, air and water, are compounds, and that a third, fire, is not a substance but a motion. The great industries that have grown out of the applications of modern scientific discoveries had no existence, and the man who should have foretold their coming into being in the days of his son would have been regarded as a mad enthusiast.

In common with many other excellent persons, Priestley believed that man is capable of reaching, and will eventually attain, perfection. If the temperature of space presented no obstacle, I should be glad to entertain the same idea; but judging from the past progress of our species, I am afraid that the globe will have cooled down so far, before the advent of this natural millennium, that we shall be, at best, perfected Esquimaux. For all practical purposes, however, it is enough that man may visibly improve his condition in the course of a century or so. And, if the picture of the state of things in Priestley's time, which I have just drawn, have any pretence to accuracy, I think it must be admitted that there has been a considerable change for the better.

I need not advert to the well-worn topic of material advancement, in a place in which the very stones testify to that progress–in the town of Watt and of Boulton. I will only remark, in passing, that material advancement has its share in moral and intellectual progress. Becky Sharp's [34] acute remark that it is not difficult to be virtuous on ten thousand a year, has its application to nations; and it is futile to expect

a hungry and squalid population to be anything but violent and gross. But as regards other than material welfare, although perfection is not yet in sight–even from the mast-head–it is surely true that things are much better than they were.

Take the upper and middle classes as a whole, and it may be said that open immorality and gross intemperance have vanished. Four and six bottle men are as extinct as the dodo. Women of good repute do not gamble, and talk modelled upon Dean Swift's "Art of Polite Conversation" would be tolerated in no decent kitchen.

Members of the legislature are not to be bought; and constituents are awakening to the fact that votes must not be sold–even for such trifles as rabbits and tea and cake. Political power has passed into the hands of the masses of the people. Those whom Priestley calls their servants have recognised their position, and have requested the master to be so good as to go to school and fit himself for the administration of his property. In ordinary life, no civil disability attaches to any one on theological grounds, and high offices of the state are open to Papist, Jew, and Secularist.

Whatever men's opinions as to the policy of Establishment, no one can hesitate to admit that [35] the clergy of the Church are men of pure life and conversation, zealous in the discharge of their duties; and at present, apparently, more bent on prosecuting one another than on meddling with Dissenters. Theology itself has broadened so much, that Anglican divines put forward doctrines more liberal than those of Priestley; and, in our state-supported churches, one listener may hear a sermon to which Bossuet might have given his approbation, while another may hear a discourse in which Socrates would find nothing new.

But great as these changes may be, they sink into insignificance beside the progress of physical science, whether we consider the improvement of methods of investigation, or the increase in bulk of solid knowledge. Consider that the labours of Laplace, of Young, of Davy, and of Faraday; of Cuvier, of Lamarck, and of Robert Brown; of Von Baer, and of Schwann; of Smith and of Hutton, have all been carried on since Priestley discovered oxygen; and consider that they are now things of the past, concealed by the industry of those who have built upon them, as the first founders of a coral reef are hidden beneath the life's work of their successors; consider that the methods of physical science are slowly spreading into all investigations, and that proofs as valid as those required by her canons of investigation are being demanded of all doctrines which ask for men's assent; and you will have a faint image of [36] the astounding difference in this respect between the nineteenth century and the eighteenth.

If we ask what is the deeper meaning of all these vast changes, I think there can be but one reply. They mean that reason has asserted and exercised her primacy over all provinces of human activity: that ecclesiastical authority has been relegated to its proper place; that the good of the governed has been finally recognised as the end of government, and the complete responsibility of governors to the people as its means; and that the dependence of natural phenomena in general on the laws of action of what we call matter has become an axiom.

But it was to bring these things about, and to enforce the recognition of these truths, that Joseph Priestley laboured. If the nineteenth century is other and better than the eighteenth, it is, in great measure, to him, and to such men as he, that we owe the change. If the twentieth century is to be better than the nineteenth, it will be because there are among us men who walk in Priestley's footsteps.

Such men are not those whom their own generation delights to honour; such men, in fact, rarely trouble themselves about honour, but ask, in another spirit than Falstaff's, "What is honour? Who hath it? He that died o' Wednesday." But whether Priestley's lot be theirs, and a future generation, in justice and in gratitude, set up [37] their statues; or whether their names and fame are blotted out from remembrance, their work will live as long as time endures. To all eternity, the sum of truth and right will have been increased by their means; to all eternity, falsehood and injustice will be the weaker because they have lived.

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[1] "Quasi cursores, vitaï lampada tradunt"–Lucr. *De Rerum Nat.* ii. 78.

[2] *Life and Correspondence of Dr. Priestley,* by J. T. Rutt. Yol. 1. p. 50.

[3] *Autobiography,* §§ 100, 101.

[4] See *The Life of Mary Anne Schimmelpenninck.* Mrs. Schimmelpenninck (*née* Galton) remembered Priestley very well and her description of him is worth quotation:–"A man of admirable simplicity, gentleness and kindness of heart, united with great acuteness of intellect. I can never forget the impression produced on me by the serene expression of his countenance. He, indeed, seemed present with God by recollection, and with man by cheerfulness. I remember that in the assembly of these distinguished men, amongst whom Mr. Boulton, by his noble manner, his fine countenance (which much resembled that of Louis XIV.), and princely munificence stood pre-eminently as the great Mecænas; even as a child, I used to feel, when Dr. Priestley entered after him, that the glory of the one vas terrestrial, that of the other celestial, and utterly far as I am removed from a belief in the sufficiency of Dr Priestley's theological creed, I cannot but here record this evidence of the eternal power of any portion of the truth held in its vitality."

[5] Even Mrs. Priestley, who might be forgiven for regarding the destroyers of her household gods with some asperity, contents herself, in writing to Mrs. Barbauld, with the sarcasm that the Birmingham people "will scarcely find so many respectable characters, a second time, to make a bonfire of."

[6] *Experiments and Observations on Different Kinds of Air,* vol. ii p. 31.

[7] *Experiments and Observations on Different Kinds of Air,* vol. ii. Pp. 34, 35.

[8] *Ibid.* vol. i p. 40.

[9] *Experiments and Observations on Different Kinds of Air,* vol. ii. p. 48.

[10] *Ibid.* p. 55.

[11] *Ibid.* p. 60. The italics are Priestley's own.

[12] "In all the newspapers and most of the periodical publications I was represented as an unbeliever in Revelation and no better than an atheist."–*Autobiography,* Rutt, vol i. p. 124. "On the walls of houses, etc., and especially where I usually went, were to be seen, in large characters, 'MADAN FOR EVER; DAMN PRIESTLEY; NO PRESBYTERIANISM; DAMN THE PRESBYTERIANS,' etc., etc.; and, at one time I was followed by a number of boys, who left their play, repeating what they had seen on the walls, and shouting out, '*Damn Priestley; damn him, damn him, for ever, for ever,*' etc., etc. This was no doubt a lesson which they had been taught by their parents and what they, I fear, had learned from their superiors."–*Appeal to the Public on the Subject of the Riots at Birmingham.*

[13] First Series. *On Some of the Peculiarities of the Christian Religion.* Essay 1. "Revelation of a Future State."

[14] Not only is Priestley at one with Bishop Courtenay in this matter, but with Hartley and Bonnet, both of them stout champions of Christianity. Moreover, Archbishop Whately's essay is little better than an expansion of the first paragraph of Hume's famous essay on the Immortality of the Soul:–"By the mere light of reason it seems difficult to prove the immortality of the soul; the arguments for it are commonly derived either from metaphysical topics, or moral, or physical. But it is in reality the Gospel, and the Gospel alone, that has brought *life and immortality to light.*" It is impossible to imagine that a man of Whately's tastes and acquirements had not read Hume or Hartley, though he refers to neither.

[15] *Essay on the First Principles of Government.* Second edition, 1771, p. 13.

[16] "Utility of Establishments," in *Essays on First Principles of Government,* p. 198, 1771.

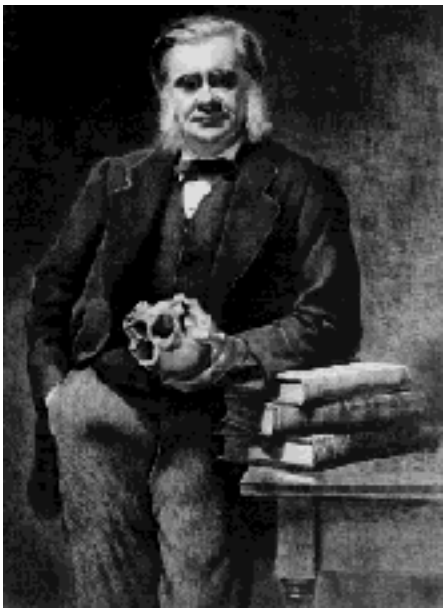
[17] In 1732 Doddridge was cited for teaching without the Bishop's leave, at Northampton.

"Our National Church"

"This way to daylight, my sons," Genesis 17:2.

by "Geefeet" (Gordon E. Flaws) 1873

THE HUXLEY FILE



Preface and Table of Contents to Volume III, *Science & Education*, of Huxley's *Collected Essays.*

Next article: On the Educational Value of the Natural History Sciences [1854], pages 38-65.

C. Blinderman & D. Joyce
Clark University

On the Educational Value of the Natural History Sciences (1854)

Collected Essays III

[38] The subject to which I have to beg your attention during the ensuing hour is "The Relation of Physiological Science to other branches of knowledge."

Had circumstances permitted of the delivery, in their strict logical order, of that series of discourses of which the present lecture is a member, I should have preceded my friend and colleague Mr. Henfrey, who addressed you on Monday last; but while, for the sake of that order, I must beg you to suppose that this discussion of the Educational bearings of Biology in general *does* precede that of Special Zoology and Botany, I am rejoiced to be able to take advantage of the light thus already thrown upon the tendency and methods of Physiological Science.

Regarding Physiological Science, then, in its [39] widest sense–as the equivalent of *Biology*–the Science of Individual Life–we have to consider in succession:

1. Its position and scope as a branch of knowledge.

2. Its value as a means of mental discipline.

3. Its worth as practical information. And lastly,

4. At what period it may best be made a branch of Education.

Our conclusions on the first of these heads must depend, of course, upon the nature of the subject-matter of Biology; and I think a few preliminary considerations will place before you in a clear light the vast difference which exists between the living bodies with which Physiological Science is concerned, and the remainder of the universe;–between the phænomena of Number and Space, of Physical and of Chemical force, on the one hand, and those of Life on the other.

The mathematician, the physicist, and the chemist contemplate things in a condition of rest; they look upon a state of equilibrium as that to which all bodies normally tend.

The mathematician does not suppose that a quantity will alter, or that a given point in space will change its direction with regard to another point, spontaneously. And it is the same with the physicist. When Newton saw the apple fall, [40] he concluded at once that the act of falling was not the result of any power inherent in the apple, but that it was the result of the action of something else on the apple. In a similar manner, all physical force is regarded as the disturbance of an equilibrium to which things tended before its exertion,–to which they will tend again after its cessation.

The chemist equally regards chemical change in a body as the effect of the action of something external to the body changed. A chemical compound once formed would persist for ever, if no alteration took place in surrounding conditions.

But to the student of Life the aspect of Nature is reversed. Here, incessant, and, so far as we know, spontaneous change is the rule, rest the exception–the anomaly to be accounted for. Living things have no inertia, and tend to no equilibrium.

Permit me, however, to give more force and clearness to these somewhat abstract considerations by an illustration or two.

Imagine a vessel full of water, at the ordinary temperature, in an atmosphere saturated with vapour. The *quantity* and the *figure* of that water will not change, so far as we know, for ever.

Suppose a lump of gold be thrown into the vessel–motion and disturbance of figure exactly proportional to the momentum of the gold will take [41] place. But after a time the effects of this disturbance will subside–equilibrium will be restored, and the water will return to its passive state.

Expose the water to cold–it will solidify–and in so doing its particles will arrange themselves in definite crystalline shapes. But once formed, these crystals change no further.

Again, substitute for the lump of gold some substance capable of entering into chemical relations with the water:–say, a mass of that substance which is called "protein"–the substance of flesh:–a very considerable disturbance of equilibrium will take place–all sorts of chemical compositions and decompositions will occur; but in the end, as before, the result will be the resumption of a condition of rest.

Instead of such a mass of *dead* protein, however, take a particle of *living* protein–one of those minute microscopic living things which throng our pools, and are known as Infusoria–such a creature, for instance, as an Euglena, and place it in our vessel of water. It is a round mass provided with a long filament, and except in this peculiarity of shape, presents no appreciable physical or chemical difference whereby it might be distinguished from the particle of dead protein.

But the difference in the phænomena to which it will give rise is immense: in the first place it will develop a vast quantity of physical force–cleaving the water in all directions with consider[42]able rapidity by means of the vibrations of the long filament of cilium.

Nor is the amount of chemical energy which the little creature possesses less striking. It is a perfect laboratory in itself, and it will act and react upon the water and the matters contained therein; converting them into new compounds resembling its own substance, and at the same time giving up portions of its own substance which have become effete.

Furthermore, the Euglena will increase in size; but this increase is by no means unlimited, as the increase of a crystal might be. After it has grown to a certain extent it divides, and each portion assumes the form of the original, and proceeds to repeat the process of growth and division.

Nor is this all. For after a series of such divisions and subdivisions, these minute points assume a totally new form, lose their long tails–round themselves, and secrete a sort of envelope or box, in which they remain shut up for a time, eventually to resume, directly or indirectly, their primitive mode of existence.

Now, so far as we know, there is no natural limit to the existence of the Euglena, or of any other living germ. A living species once launched into existence tends to live for ever.

Consider how widely different this living particle is from the dead atoms with which the physicist and chemist have to do!

[43] The particle of gold falls to the bottom and rests–the particle of dead protein decomposes and disappears–it also rests: but the *living* protein mass neither tends to exhaustion of its forces nor to any permanency of form, but is essentially distinguished as a disturber of equilibrium so far as force is concerned,–as undergoing continual metamorphosis and change, in point of form.

Tendency to equilibrium of force and to permanency of form, then, are the characters of that portion of the universe which does not live–the domain of the chemist and physicist.

Tendency to disturb existing equilibrium–to take on forms which succeed one another in definite cycles–is the character of the living world.

What is the cause of this wonderful difference between the dead particle and the living particle of matter appearing in other respects identical? that difference to which we give the name of Life?

I, for one, cannot tell you. It may be that, by and by, philosophers will discover some higher laws of which the facts of life are particular cases–very possibly they will find out some bond between physico-chemical phænomena on the one hand, and vital phænomena on the other. At present, however, we assuredly know of none; and I think we shall exercise a wise humility in confessing that, for us at least, this successive assumption of different states–(external conditions [44] remaining the same)–that *spontaneity of action* if I may use the term which implies more than I would be answerable for–which constitutes so vast and plain a practical distinction between living bodies and those which do not live, is an ultimate fact; indicating as such, the existence of a broad line of demarcation between the subject-matter of Biological and that of all other Sciences.

For I would have it understood that this simple Euglena is the type of *all* living things, so far as the distinction between these and inert matter is concerned. That cycle of changes, which is constituted by perhaps not more than two or three steps in the Euglena, is as clearly manifested in the multitudinous stages through which the germ of an oak or of a man passes. Whatever forms the Living Being may take

on, whether simple or complex, *production, growth, reproduction,* are the phænomena which distinguish it from that which does not live.

If this be true, it is clear that the student, in passing from the physico-chemical to the physiological sciences, enters upon a totally new order of facts; and it will next be for us to consider how far these new facts involve *new* methods, or require a modification of those with which he is already acquainted. Now a great deal is said about the peculiarity of the scientific method in general, and of the different methods which are pursued in the [45] different sciences. The Mathematics are said to have one special method; Physics another, Biology a third, and so forth. For my own part, I must confess that I do not understand this phraseology.

So far as I can arrive at any clear comprehension of the matter, Science is not, as many would seem to suppose, a modification of the black art, suited to the tastes of the nineteenth century, and flourishing mainly in consequence of the decay of the Inquisition.

Science is, I believe, nothing but *trained and organised common sense,* differing from the latter only as a veteran may differ from a raw recruit: and its methods differ from those of common sense only so far as the guardsman's cut and thrust differ from the manner in which a savage wields his club. The primary power is the same in each case, and perhaps the untutored savage has the more brawny arm of the two. The *real* advantage lies in the point and polish of the swordsman's weapon; in the trained eye quick to spy out the weakness of the adversary; in the ready hand prompt to follow it on the instant. But, after all, the sword exercise is only the hewing and poking of the clubman developed and perfected.

So, the vast results obtained by Science are won by no mystical faculties, by no mental processes, other than those which are practised by every one of us, in the humblest and meanest affairs of life. A detective policeman discovers a burglar from the [46] marks made by his shoe, by a mental process identical with that by which Cuvier restored the extinct animals of Montmartre from fragments of their bones. Nor does that process of induction and deduction by which a lady, finding a stain of a peculiar kind upon her dress, concludes that somebody has upset the inkstand thereon, differ in any way, in kind, from that by which Adams and Leverrier discovered a new planet.

The man of science, in fact, simply uses with scrupulous exactness the methods which we all, habitually and at every moment, use carelessly; and the man of business must as much avail himself of the scientific method–must be as truly a man of science–as the veriest bookworm of us all; though I have no doubt that the man of business will find himself out to be a philosopher with as much surprise as M. Jourdain exhibited when he discovered that he had been all his life talking prose. If, however, there be no real difference between the methods of science and those of common life, it would seem, on the face of the matter, highly improbable that there should be any difference between the methods of the different sciences; nevertheless, it is constantly taken for granted that there is a very wide difference between the Physiological and other sciences in point of method.

In the first place it is said–and I take this point first, because the imputation is too frequently ad[47]

mitted by Physiologists themselves–that Biology differs from the Physico-chemical and Mathematical sciences in being "inexact."

Now, this phrase "inexact" must refer either to the *methods* or to the *results* of Physiological science.

It cannot be correct to apply it to the methods; for, as I hope to show you by and by, these are identical in all sciences, and whatever is true of Physiological method is true of Physical and Mathematical method.

Is it then the *results* of Biological science which are "inexact"? I think not. If I say that respiration is performed by the lungs; that digestion is effected in the stomach; that the eye is the organ of sight; that the jaws of a vertebrated animal never open sideways, but always up and down; while those of an annulose animal always open sideways, and never up and down–I am enumerating propositions which are as exact as anything in Euclid. How then has this notion of the inexactness of Biological science come about? I believe from two causes: first, because in consequence of the great complexity of the science and the multitude of interfering conditions, we are very often only enabled to predict approximately what will occur under given circumstances; and secondly, because, on account of the comparative youth of the Physiological sciences, a great many of their laws are still imperfectly worked out. [48] But, in an educational point of view, it is most important to distinguish between the essence of a science and the accidents which surround it; and essentially, the methods and results of Physiology are as exact as those of Physics or Mathematics.

It is said that the Physiological method is especially *comparative;*[1] and this dictum also finds favour in the eyes of many. I should be sorry to suggest that the speculators on scientific classification have been misled by the accident of the name of one leading branch of Biology–*Comparative Anatomy;* but I would ask whether *comparison,* and that classification which is the result of comparison, are not the essence of every science whatsoever? How is it possible to discover a relation of cause and effect of *any* kind without comparing a series of cases together in which the supposed cause and effect occur singly, or combined? [49] So far from comparison being in any way peculiar to Biological science, it is, I think, the essence of every science.

A speculative philosopher again tells us that the Biological sciences are distinguished by being sciences of observation and not of experiment![2]

Of all the strange assertions into which speculation without practical acquaintance with a subject may lead even an able man, I think this is the very strangest. Physiology not an experimental science? Why, there is not a function of a single organ in the body which has not been determined wholly and solely by experiment? How did Harvey determine the nature of the circulation, except by experiment? How did Sir Charles Bell determine the functions of the roots of the spinal nerve, save by experiment? How do we know the use of a nerve at all, except by experiment? Nay, how do we know even that your eye is your seeing apparatus, unless you make the experiment of shutting it; or that your ear is [50] your hearing apparatus, unless you close it up and thereby discover that you become deaf?

It would really be much more true to say that Physiology is *the* experimental science *par excellence* of all sciences; that in which there is least to be learnt by mere observation, and that which affords the greatest field for the exercise of those faculties which characterise the experimental philosopher. I confess, if any one were to ask me for a model application of the logic of experiment, I should know no better work to put into his hands than Bernard's late Researches on the Functions of the Liver.[3]

Not to give this lecture a too controversial tone, however, I must only advert to one more doctrine, held by a thinker of our own age and country, whose opinions are worthy of all respect. It is, that the Biological sciences differ from all others, inasmuch as in *them* classification takes place by type and not by definition.[4]

It is said, in short, that a natural-history class is not capable of being defined–that the class [51] Rosaceæ, for instance, or the class of Fishes, is not accurately and absolutely definable, inasmuch as its members will present exceptions to every possible definition; and that the members of the class are united together only by the circumstance that they are all more like some imaginary average rose or average fish, than they resemble anything else.

But here, as before, I think the distinction has arisen entirely from confusing a transitory imperfection with an essential character. So long as our information concerning them is imperfect, we class all objects together according to resemblances which we *feel,* but cannot *define;* we group them round *types,* in short. Thus if you ask an ordinary person what kinds of animals there are, he will probably say, beasts, birds, reptiles, fishes, insects, &c. Ask him to define a beast from a reptile, and he cannot do it; but he says, things like a cow or a horse are beasts, and things like a frog or a lizard are reptiles. You see *he does* class by type, and not by definition. But how does this classification differ from that of a scientific Zoologist? How does the meaning of the scientific class name of "Mammalia" differ from the unscientific of "Beasts"?

[52] Why, exactly because the former depends on a definition, the latter on a type. The class Mammalia is scientifically defined as "all animals which have a vertebrated skeleton and suckle their young." Here is no reference to type, but a definition rigorous enough for a geometrician. And such is the character which every scientific naturalist recognises as that to which his classes must aspire–knowing, as he does, that classification by type is simply an acknowledgment of ignorance and a temporary device.

So much in the way of negative argument as against the reputed differences between Biological and other methods. No such differences, I believe, really exist. The subject-matter of Biological science is different from that of other sciences, but the methods of all are identical; and these methods are–

1. *Observation* of facts–including under this head that *artificial observation* which is called *experiment.*

2. That process of tying up similar facts into bundles ticketed and ready for use, which is called *Comparison* and *Classification,*–the results of the process, the ticketed bundles, being named *General*

propositions.

3. *Deduction,* which takes us from the general proposition to facts again–teaches us, if I may so say, to anticipate from the ticket what is inside the bundle. And finally

[53] 4. *Verification,* which is the process of ascertaining whether, in point of fact, our anticipation is a correct one.

Such are the methods of all science whatsoever; but perhaps you will permit me to give you an illustration of their employment in the science of Life; and I will take as a special case the establishment of the doctrine of the *Circulation of the Blood.*

In this case, *simple observation* yields us a knowledge of the existence of the blood from some accidental hæmorrhage, we will say; we may even grant that it informs us of the localisation of this blood in particular vessels, the heart, &c., from some accidental cut or the like. It teaches also the existence of a pulse in various parts of the body, and acquaints us with the structure of the heart and vessels.

Here, however, *simple observation* stops, and we must have recourse to *experiment.*

You tie a vein, and you find that the blood accumulates on the side of the ligature opposite the heart. You tie an artery, and you find that the blood accumulates on the side near the heart. Open the chest, and you see the heart contracting with great force. Make openings into its principal cavities, and you will find that all the blood flows out, and no more pressure is exerted on either side of the arterial or venous ligature.

Now all these facts, taken together, constitute [54] the evidence that the blood is propelled by the heart through the arteries, and returns by the veins–that, in short, the blood circulates.

Suppose our experiments and observations have been made on horses, then we group and ticket them into a general proposition, thus:–*all horses have a circulation of their blood.*

Henceforward a horse is a sort of indication or label, telling us where we shall find a peculiar series of phænomena called the circulation of the blood.

Here is our *general proposition,* then.

How, and when, are we justified in making our next step–a *deduction* from it?

Suppose our physiologist, whose experience is limited to horses, meets with a zebra for the first time,–will he suppose that this generalisation holds good for zebras also?

That depends very much on his turn of mind. But we will suppose him to be a bold man. He will say, "The zebra is certainly not a horse, but it is very like one,–so like, that it must be the 'ticket' or mark of a blood-circulation also; and I conclude that the zebra has a circulation."

That is a deduction, a very fair deduction, but by no means to be considered scientifically secure. This last quality in fact can only be given by *verification*–that is, by making a zebra the subject of all the experiments performed on the horse. Of course, in the present case, the *deduction* would be [55] *confirmed* by this process of verification, and the result would be, not merely a positive widening of knowledge, but a fair increase of confidence in the truth of one's generalisations in other cases.

Thus, having settled the point in the zebra and horse, our philosopher would have great confidence in the existence of a circulation in the ass. Nay, I fancy most persons would excuse him, if in this case he did not take the trouble to go through the process of verification at all; and it would not be without a parallel in the history of the human mind, if our imaginary physiologist now maintained that he was acquainted with asinine circulation *a priori.*

However, if I might impress any caution upon your minds, it is, the utterly conditional nature of all our knowledge,–the danger of neglecting the process of verification under any circumstances; and the film upon which we rest, the moment our deductions carry us beyond the reach of this great process of verification. There is no better instance of this than is afforded by the history of our knowledge of the circulation of the blood in the animal kingdom until the year 1824. In every animal possessing a circulation at all, which had been observed up to that time, the current of the blood was known to take one definite and invariable direction. Now, there is a class of animals called *Ascidians,* which possess a heart and a circulation, and up to the period of which I speak, [56] no one would have dreamt of questioning the propriety of the deduction, that these creatures have a circulation in one direction; nor would any one have thought it worth while to verify the point. But, in that year, M. von Hasselt, happening to examine a transparent animal of this class, found, to his infinite surprise, that after the heart had beat a certain number of times, it stopped, and then began beating the opposite way–so as to reverse the course of the current, which returned by and by to its original direction.

I have myself timed the heart of these little animals. I found it as regular as possible in its periods of reversal: and I know no spectacle in the animal kingdom more wonderful than that which it presents–all the more wonderful that to this day it remains an unique fact, peculiar to this class among the whole animated world. At the same time I know of no more striking case of the necessity of the *verification* of even those deductions which seem founded on the widest and safest inductions.

Such are the methods of Biology–methods which are obviously identical with those of all other sciences, and therefore wholly incompetent to form the ground of any distinction between it and them.[5]

[57] But I shall be asked at once, Do you mean to say that there is no difference between the habit of mind of a mathematician and that of a naturalist? Do you imagine that Laplace might have been put into the Jardin des Plantes, and Cuvier into the Observatory, with equal advantage to the progress of the

sciences they professed?

To which I would reply, that nothing could be further from my thoughts. But different habits and various special tendencies of two sciences do not imply different methods. The mountaineer and the man of the plains have very different habits of progression, and each would be at a loss in the other's place; but the method of progression, by putting one leg before the other, is the same in each case. Every step of each is a combination of a lift and a push; but the mountaineer lifts more and the lowlander pushes more. And I think the case of two sciences resembles this.

I do not question for a moment, that while the Mathematician is busy with deductions *from* general propositions, the Biologist is more especially occupied with observation, comparison, and those processes which lead *to* general propositions. All I wish to insist upon is, that this difference depends not on any fundamental distinction in the sciences themselves, but on the accidents of their subject-matter, of their relative complexity, and consequent relative perfection.

The Mathematician deals with two properties of [58] objects only, number and extension, and all the inductions he wants have been formed and finished ages ago. He is occupied now with nothing but deduction and verification.

The Biologist deals with a vast number of properties of objects, and his inductions will not be completed, I fear, for ages to come; but when they are, his science will be as deductive and as exact as the Mathematics themselves.

Such is the relation of Biology to those sciences which deal with objects having fewer properties than itself. But as the student, in reaching Biology, looks back upon sciences of a less complex and therefore more perfect nature; so, on the other hand, does he look forward to other more complex and less perfect branches of knowledge. Biology deals only with living beings as isolated things–treats only of the life of the individual: but there is a higher division of science still, which considers living beings as aggregates–which deals with the relation of living beings one to another–the science which *observes* men–whose *experiments* are made by nations one upon another, in battle-fields–whose *general propositions* are embodied in history, morality, and religion–whose *deductions* lead to our happiness or our misery–and whose *verifications* so often come too late, and serve only

"To point a moral, or adorn a tale"–

I mean the science of Society or *Sociology*.

[59] I think it is one of the grandest features of Biology, that it occupies this central position in human knowledge. There is no side of the human mind which physiological study leaves uncultivated. Connected by innumerable ties with abstract science, Physiology is yet in the most intimate relation with humanity; and by teaching us that law and order, and a definite scheme of development, regulate even the strangest and wildest manifestations of individual life, she prepares the student to look for a goal

even amidst the erratic wanderings of mankind, and to believe that history offers something more than an entertaining chaos–a journal of a toilsome, tragi-comic march no-whither.

The preceding considerations have, I hope, served to indicate the replies which befit the first two of the questions which I set before you at starting, viz. What is the range and position of Physiological Science as a branch of knowledge, and what is its value as a means of mental discipline?

Its *subject-matter* is a large moiety of the universe–its *position* is midway between the physico-chemical and the social sciences. Its *value* as a branch of discipline is partly that which it has in common with all sciences–the training and strengthening of common sense; partly that which is more peculiar to itself–the great exercise which it affords to the faculties of observation and [60] comparison; and, I may add, the *exactness* of knowledge which it requires on the part of those among its votaries who desire to extend its boundaries.

If what has been said as to the position and scope of Biology be correct, our third question–What is the practical value of physiological instruction?–might, one would think, be left to answer itself.

On other grounds even, were mankind deserving of the title "rational," which they arrogate to themselves, there can be no question that they would consider, as the most necessary of all branches of instruction for themselves and for their children, that which professes to acquaint them with the conditions of the existence they prize so highly–which teaches them how to avoid disease and to cherish health, in themselves and those who are dear to them.

I am addressing, I imagine, an audience of educated persons; and yet I dare venture to assert that, with the exception of those of my hearers who may chance to have received a medical education, there is not one who could tell me what is the meaning and use of an act which he performs a score of times every minute, and whose suspension would involve his immediate death;–I mean the act of breathing–or who could state in precise terms why it is that a confined atmosphere is injurious to health.

[61] The *practical value* of Physiological knowledge! Why is it that educated men can be found to maintain that a slaughter-house in the midst of a great city is rather a good thing than otherwise?–that mothers persist in exposing the largest possible amount of surface of their children to the cold, by the absurd style of dress they adopt, and then marvel at the peculiar dispensation of Providence, which removes their infants by bronchitis and gastric fever? Why is it that quackery rides rampant over the land; and that not long ago, one of the largest public-rooms in this great city could be filled by an audience gravely listening to the reverend expositor of the doctrine–that the simple physiological phænomena known as spirit-rapping, table-turning, phreno-magnetism, and I know not what other absurd and inappropriate names, are due to the direct and personal agency of Satan?

Why is all this, except from the utter ignorance as to the simplest laws of their own animal life, which prevails among even the most highly educated persons in this country?

But there are other branches of Biological Science, besides Physiology proper, whose practical influence, though less obvious, is not, as I believe, less certain. I have heard educated men speak with an ill-disguised contempt of the studies of the naturalist, and ask, not without a shrug, "What is the use of knowing all about these miserable animals–what bearing has it on human life?"

[62] I will endeavour to answer that question. I take it that all will admit there is definite Government of this universe–that its pleasures and pains are not scattered at random, but are distributed in accordance with orderly and fixed laws, and that it is only in accordance with all we know of the rest of the world, that there should be an agreement between one portion of the sensitive creation and another in these matters.

Surely then it interests us to know the lot of other animal creatures–however far below us, they are still the sole created things which share with us the capability of pleasure and the susceptibility to pain.

I cannot but think that he who finds a certain proportion of pain and evil inseparably woven up in the life of the very worms, will bear his own share with more courage and submission; and will, at any rate, view with suspicion those weakly amiable theories of the Divine government, which would have us believe pain to be an oversight and a mistake,–to be corrected by and by. On the other hand, the predominance of happiness among living things–their lavish beauty–the secret and wonderful harmony which pervades them all, from the highest to the lowest, are equally striking refutations of that modern Manichean doctrine, which exhibits the world as a slave-mill, worked with many tears, for mere utilitarian ends.

There is yet another way in which natural history [63] may, I am convinced, take a profound hold upon practical life,–and that is, by its influence over our finer feelings, as the greatest of all sources of that pleasure which is derivable from beauty. I do not pretend that natural-history knowledge, as such, can increase our sense of the beautiful in natural objects. I do not suppose that the dead soul of Peter Bell, of whom the great poet of nature says,–

> A primrose by the river's brim,
> A yellow primrose was to him,–
> And it was nothing more,–

would have been a whit roused from its apathy by the information that the primrose is a Dicotyledonous Exogen, with a monopetalous corolla and central placentation. But I advocate natural-history knowledge from this point of view, because it would lead us to *seek* the beauties of natural objects, instead of trusting to chance to force them on our attention. To a person uninstructed in natural history, his country or sea-side stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall. Teach him something of natural history, and you place in his hands a catalogue of those which are worth turning round. Surely our innocent pleasures are not so abundant in this life, that we can afford to despise this or any other source of them. We should fear being banished for our neglect to that limbo, where the great [64] Florentine tells us are those who, during this life,

"wept when they might be joyful."

But I shall be trespassing unwarrantably on your kindness, if I do not proceed at once to my last point–the time at which Physiological Science should first form a part of the Curriculum of Education.

The distinction between the teaching of the facts of a science as instruction, and the teaching it systematically as knowledge, has already been placed before you in a previous lecture: and it appears to me that, as with other sciences, the *common facts* of Biology–the uses of parts of the body–the names and habits of the living creatures which surround us–may be taught with advantage to the youngest child. Indeed, the avidity of children for this kind of knowledge, and the comparative ease with which they retain it, is something quite marvellous. I doubt whether any toy would be so acceptable to young children as a vivarium of the same kind as, but of course on a smaller scale than, those admirable devices in the Zoological Gardens.

On the other hand, systematic teaching in Biology cannot be attempted with success until the student has attained to a certain knowledge of physics and chemistry: for though the phænomena of life are dependent neither on physical nor on chemical, but on vital forces, yet they result in all sorts of physical and chemical [65] changes, which can only be judged by their own laws.

And now to sum up in a few words the conclusions to which I hope you see reason to follow me.

Biology needs no apologist when she demands a place–and a prominent place–in any scheme of education worthy of the name. Leave out the Physiological sciences from your curriculum, and you launch the student into the world, undisciplined in that science whose subject-matter would best develop his powers of observation; ignorant of facts of the deepest importance for his own and others' welfare; blind to the richest sources of beauty in God's creation; and unprovided with that belief in a living law, and an order manifesting itself in and through endless change and variety, which might serve to check and moderate that phase of despair through which, if he take an earnest interest in social problems, he will assuredly sooner or later pass.

Finally, one word for myself. I have not hesitated to speak strongly where I have felt strongly; and I am but too conscious that the indicative and imperative moods have too often taken the place of the more becoming subjunctive and conditional. I feel, therefore, how necessary it is to beg you to forget the personality of him who has thus ventured to address you, and to consider only the truth or error in what has been said.

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[1] "In the third place, we have to review the method of comparison, which is so specially adapted to the study of living bodies, and by which, above all others, that study must be advanced. In Astronomy, this method is necessarily inapplicable; and it is not till we arrive at Chemistry that this third means of investigation can be used; and then only in subordination to the two others. It is in the study. both statical and dynamical, of living

bodies that it first acquires its full development; and its use elsewhere can be only through its application here."–Comte's *Positive Philosophy,* translated by Miss Martineau. Vol. i. p. 372.

By what method does M. Comte suppose that the equality or inequality of forces and quantities and the dissimilarity or similarity of forms–points out some slight importance not only in Astronomy and Physics, but even in Mathematics–are ascertained, if not by Comparison?

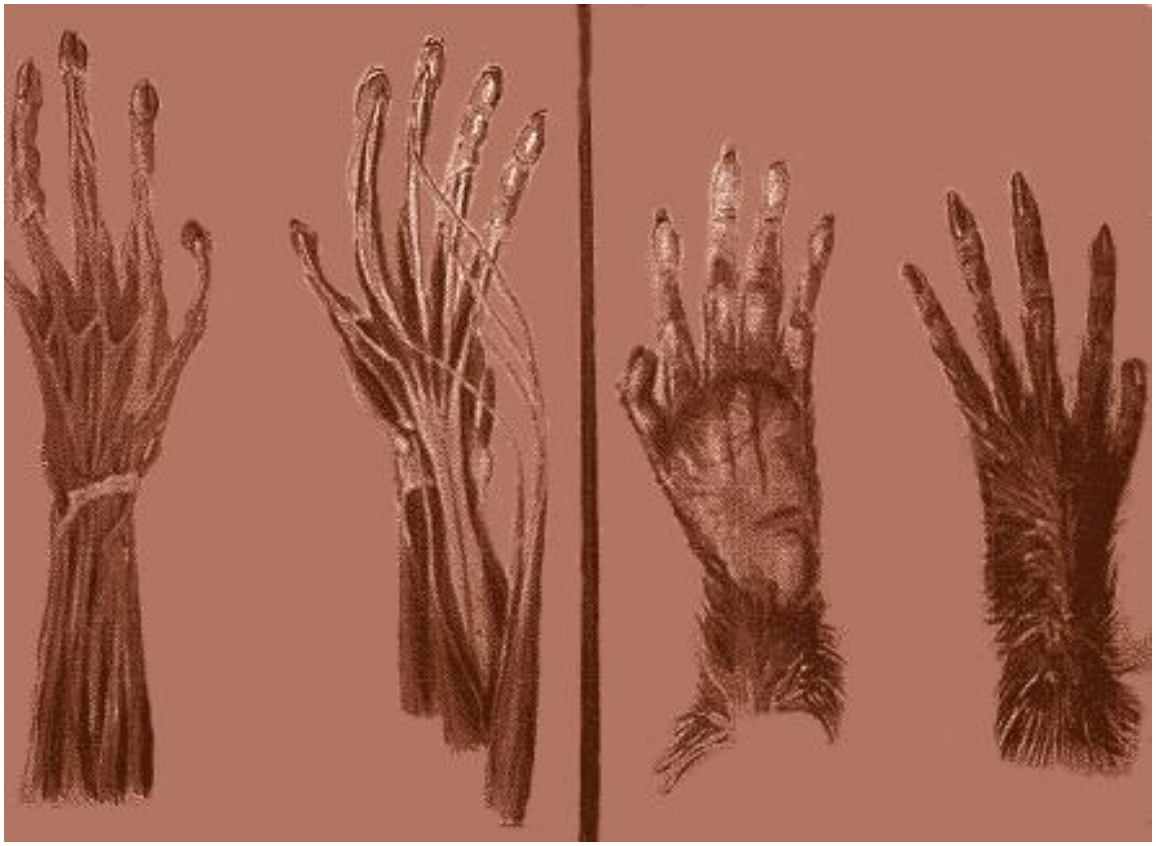
[2] "Proceeding to the second class of means–Experiment cannot but be less and less decisive, in proportion to the complexity of the phænomena to be explored; and therefore we saw this resource to be less effectual in chemistry than in physics: and we now find that it is eminently useful in chemistry in comparison with physiology. *In fact, the nature of the phænomena seems to offer almost insurmountable impediments to any extensive and prolific application of such a procedure in biology.*"–Comte, vol. 1, p. 367.

M. Comte, as his manner is, contradicts himself two pages further on, but that will hardly relieve him from the responsibility of such a paragraph as the above.

[3] *Nouvelle Fonction du Foie considéré comme organe producteur de matiére sucrée chez l'Homme et les Animalaux,* par M. Claude Bernard.

[4] "*Natural Groups given by Type, not by Definition. . . .* The class is steadily fixed, though not precisely limited; it is given, though not circumscribed; it is determined, not by a boundary-line without, but by a central point within; not by what it strictly excludes, but what it eminently includes; by an example, not by a precept; in short, instead of Definition we have a*Type* for our director. A type is an example of any class, for instance, a species of a genus, which is considered as eminently possessing the characters of the class. All the species which have a greater affinity with this type-species than with any others, form the genus, and are ranged about it, deviating from it in various directions and different degrees."–Whewell, *The Philosophy of the Inductive Sciences,* vol. 12, pp. 476, 477.

[5] Save for the pleasure of doing so, I need hardly point out my obligations to Mr. J. S. Mill's *System of Logic,* in this view of scientific method.



Gibbon Hands

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THE HUXLEY FILE

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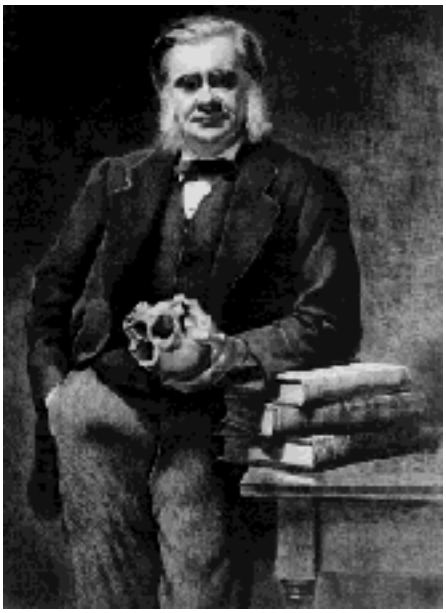

Emancipation–Black and White (1865)

Collected Essays III

[66] QUASHIE'S plaintive inquiry, "Am I not a man and a brother?" seems at last to have received its final reply–the recent decision of the fierce trial by battle on the other side of the Atlantic fully concurring with that long since delivered here in a more peaceful way.

The question is settled; but even those who are most thoroughly convinced that the doom is just, must see good grounds for repudiating half the arguments which have been employed by the winning side; and for doubting whether its ultimate results will embody the hopes of the victors, though they may more than realise the fears of the vanquished. It may be quite true that some negroes are better than some white men; but no rational man, cognisant of the facts, believes that the average negro is the equal, still [67] less the superior, of the average white man. And, if this be true, it is simply incredible that, when all his disabilities are removed, and our prognathous relative has a fair field and no favour, as well as no oppressor, he will be able to compete successfully with his bigger-brained and smaller-jawed rival, in a contest which is to be carried on by thoughts and not by bites. The highest places in the hierarchy of civilisation will assuredly not be within the reach of our dusky cousins, though it is by no means necessary that they should be restricted to the lowest.

But whatever the position of stable equilibrium into which the laws of social gravitation may bring the negro, all responsibility for the result will henceforward lie between nature and him. The white man may wash his hands of it, and the Caucasian conscience be void of reproach for evermore. And this, if we look to the bottom of the matter, is the real justification for the abolition policy.

The doctrine of equal natural rights may be an illogical delusion; emancipation may convert the slave from a well-fed animal into a pauperised man; mankind may even have to do without cotton-shirts; but all these evils must be faced if the moral law, that no human being can arbitrarily dominate over another without grievous damage to his own nature, be, as many think, as readily demonstrable by experiment as any physical truth. If this be true, no slavery can [68] be abolished without a double emancipation, and the master will benefit by freedom more than the freed-man.

The like considerations apply to all the other questions of emancipation which are at present stirring the world–the multifarious demands that classes of mankind shall be relieved from restrictions imposed by the artifice of man, and not by the necessities of nature. One of the most important, if not the most important, of all these, is that which daily threatens to become the "irrepressible" woman question. What social and political rights have women? What ought they to be allowed, or not allowed, to do, be, and suffer? And, as involved in and underlying all these questions, how ought they to be educated?

There are philogynists as fanatical as any "miscegynists" who, reversing our antiquated notions, bid the man look upon the woman as the higher type of humanity; who ask us to regard the female intellect as

the clearer and the quicker, if not the stronger; who desire us to look up to the feminine moral sense as the purer and the nobler; and bid man abdicate his usurped sovereignty over nature in favour of the female line. On the other hand, there are persons not to be outdone in all loyalty and just respect for womankind, but by nature hard of head and haters of delusion, however charming, who not only repudiate the new woman-worship [69] which so many sentimentalists and some philosophers are desirous of setting up, but, carrying their audacity further, deny even the natural equality of the sexes. They assert, on the contrary, that in every excellent character, whether mental or physical, the average woman is inferior to the average man, in the sense of having that character less in quantity and lower in quality.

Tell these persons of the rapid perceptions and the instinctive intellectual insight of women, and they reply that the feminine mental peculiarities which pass under these names are merely the outcome of a greater impressibility to the superficial aspects of things, and of the absence of that restraint upon expression which, in men, is imposed by reflection and a sense of responsibility. Talk of the passive endurance of the weaker sex, and opponents of this kind remind you that Job was a man, and that, until quite recent times, patience and long-suffering were not counted among the specially feminine virtues. Claim passionate tenderness as especially feminine, and the inquiry is made whether all the best love-poetry in existence (except, perhaps, the "Sonnets from the Portuguese") has not been written by men; whether the song which embodies the ideal of pure and tender passion–"Adelaida"–was written by *Frau* Beethoven; whether it was the Fornarina, or Raphael, who painted the Sistine Madonna. Nay, we have known one such [70] heretic go so far as to lay his hands upon the ark itself, so to speak and to defend the startling paradox that, even in physical beauty, man is the superior. He admitted, indeed, that there was a brief period of early youth when it might be hard to say whether the prize should be awarded to the graceful undulations of the female figure, or the perfect balance and supple vigour of the male frame. But while our new Paris might hesitate between the youthful Bacchus and the Venus emerging from the foam, he averred that, when Venus and Bacchus had reached thirty, the point no longer admitted of a doubt; the male form having then attained its greatest nobility, while the female is far gone in decadence; and that, at this epoch, womanly beauty, so far as it is independent of grace or expression, is a question of drapery and accessories.

Supposing, however, that all these arguments have a certain foundation; admitting, for a moment, that they are comparable to those by which the inferiority of the negro to the white man may be demonstrated, are they of any value as against woman-emancipation? Do they afford us the smallest ground for refusing to educate women as well as men–to give women the same civil and political rights as men? No mistake is so commonly made by clever people as that of assuming a cause to be bad because the arguments of its supporters are, to a great extent, non[71]sensical. And we conceive that those who may laugh at the arguments of the extreme philogynists, may yet feel bound to work heart and soul towards the attainment of their practical ends.

As regards education, for example. Granting the alleged defects of women, is it not somewhat absurd to sanction and maintain a system of education which would seem to have been specially contrived to exaggerate all these defects?

Naturally not so firmly strung, nor so well balanced as boys, girls are in great measure debarred from the sports and physical exercises which are justly thought absolutely necessary for the full development of the vigour of the more favoured sex. Women are by nature more excitable than men–prone to be swept by tides of emotion, proceeding from hidden and inward, as well as from obvious and external causes; and female education does its best to weaken every physical counterpoise to this nervous mobility–tends in all ways to stimulate the emotional part of the mind and stunt the rest. We find girls naturally timid, prone to dependence, born conservatives; and we teach them that independence is unladylike; that blind faith is the right frame of mind; and that whatever we may be permitted, and indeed encouraged, to do to our brother, our sister is to be left to the tyranny of authority and tradition. With few insignificant [72] exceptions, girls have been educated either to be drudges, or toys, beneath man, or a sort of angels above him; the highest ideal aimed at oscillating between Clarchen and Beatrice. The possibility that the ideal of womanhood lies neither in the fair saint, nor in the fair sinner; that the female type of character is neither better nor worse than the male, but only weaker; that women are meant neither to be men's guides nor their playthings, but their comrades, their fellows and their equals, so far as nature puts no bar to that equality, does not seem to have entered into the minds of those who have had the conduct of the education of girls.

If the present system of female education stands self-condemned, as inherently absurd; and if that which we have just indicated is the true position of woman, what is the first step towards a better state of things? We reply, emancipate girls. Recognise the fact that they share the senses, perceptions, feelings, reasoning powers, emotions, of boys, and that the mind of the average girl is less different from that of the average boy, than the mind of one boy is from that of another; so that whatever argument justifies a given education for all boys justifies its application to girls as well. So far from imposing artificial restrictions upon the acquirement of knowledge by women, throw every facility in their [73] way. Let our Faustinas, if they will, toil through the whole round of

> "Juristerei und Medizin
> Und leider! auch Philosophie."

Let us have "sweet girl graduates" by all means. They will be none the less sweet for a little wisdom; and the "golden hair" will not curl less gracefully outside the head by reason of there being brains within. Nay, if obvious practical difficulties can be overcome, let those women who feel inclined to do so, descend into the gladiatorial arena of life, not merely in the guise of *retiartiæ* as heretofore, but as bold *sicariæ,* breasting the open fray. Let them, if they so please, become merchants, barristers, politicians. Let them have a fair field, but let them understand, as the necessary correlative, that they are to have no favour. Let nature alone sit high above the lists, "rain influence and judge the prize."

And the result? For our parts, though loth to prophecy, we believe it will be that of other emancipations. Women will find their place, and it will neither be that in which they have been held, nor that to which some of them aspire. Nature's old salique law will not be repealed, and no change of dynasty will be effected. The big chests, the massive brains, the vigorous muscles and stout frames of the best men will carry the day, whenever it is worth their while to contest [74] the prizes of life with the best women. And the hardship of it is, that the very improvement of the women will lessen their chances. Better

mothers will bring forth better sons, and the impetus gained by the one sex will be transmitted, in the next generation, to the other. The most Darwinian of theorists will not venture to propound the doctrine, that the physical disabilities under which women have hitherto laboured in the struggle for existence with men, are likely to be removed by even the most skilfully conducted process of educational selection.

We are, indeed, fully prepared to believe that the bearing of children may, and ought, to become as free from danger and long disability to the civilised woman as it is to the savage; nor is it improbable that, as society advances towards its right organisation, motherhood will occupy a less space of woman's life than it has hitherto done. But still, unless the human species is to come to an end altogether–a consummation which can hardly be desired by even the most ardent advocate of "women's rights"–somebody must be good enough to take the trouble and responsibility of annually adding to the world exactly as many people as die out of it. In consequence of some domestic difficulties, Sydney Smith is said to have suggested that it would have been good for the human race had the model offered by the hive been followed, and had all the working part of the [75] female community been neuters. Failing any thorough-going reform of this kind, we see nothing for it but the old division of humanity into men potentially, or actually, fathers, and women potentially, if not actually, mothers. And we fear that so long as. this potential motherhood is her lot, woman will be found to be fearfully weighted in the race of life.

The duty of man is to see that not a grain is piled upon that load beyond what nature imposes; that injustice is not added to inequality.

THE HUXLEY FILE

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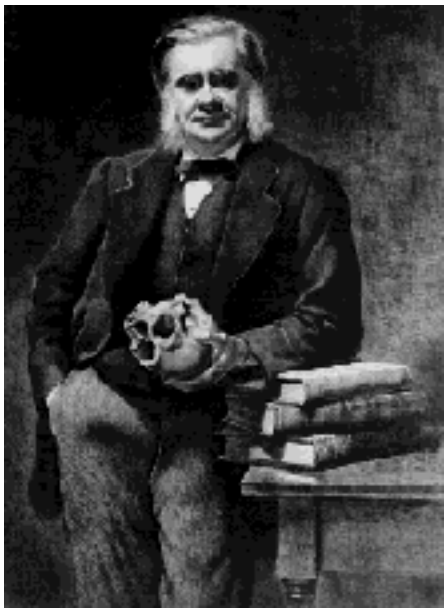
Previous article: On the Educational Value of the Natural History Sciences [1854], pages 38-65.



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A Liberal Education and Where to Find It (1868)

Collected Essays III

[76] The business which the South London Working Men's College has undertaken is a great work; indeed, I might say, that Education, with which that college proposes to grapple, is the greatest work of all those which lie ready to a man's hand just at present.

And, at length, this fact is becoming generally recognised. You cannot go anywhere without hearing a buzz of more or less confused and contradictory talk on this subject–nor can you fail to notice that, in one point at any rate, there is a very decided advance upon like discussions in former days. Nobody outside the agricultural interest now dares to say that education is a bad thing. If any representative of the once large and powerful party, which, in former days, proclaimed this opinion, still exists in the semi-fossil [77] state, he keeps his thoughts to himself. In fact, there is a chorus of voices, almost distressing in their harmony, raised in favour of the doctrine that education is the great panacea for human troubles, and that, if the country is not shortly to go to the dogs, everybody must be educated.

The politicians tell us, "You must educate the masses because they are going to be masters." The clergy join in the cry for education, for they affirm that the people are drifting away from church and chapel into the broadest infidelity. The manufacturers and the capitalists swell the chorus lustily. They declare that ignorance makes bad workmen; that England will soon be unable to turn out cotton goods, or steam engines, cheaper than other people; and then, Ichabod! Ichabod! the glory will be departed from us. And a few voices are lifted up in favour of the doctrine that the masses should be educated because they are men and women with unlimited capacities of being, doing, and suffering, and that it is as true now, as it ever was, that the people perish for lack of knowledge.

These members of the minority, with whom I confess I have a good deal of sympathy, are doubtful whether any of the other reasons urged in favour of the education of the people are of much value–whether, indeed, some of them are based upon either wise or noble grounds of action. They question if it be wise to tell people that you [78] will do for them, out of fear of their power, what you have left undone, so long as your only motive was compassion for their weakness and their sorrows. And, if ignorance of everything which it is needful a ruler should know is likely to do so much harm in the governing classes of the future, why is it, they ask reasonably enough, that such ignorance in the governing classes of the past has not been viewed with equal horror?

Compare the average artisan and the average country squire, and it may be doubted if you will find a pin to choose between the two in point of ignorance, class feeling, or prejudice. It is true that the ignorance is of a different sort–that the class feeling is in favour of a different class–and that the prejudice has a distinct savour of wrong-headedness in each case–but it is questionable if the one is either a bit better, or a bit worse, than the other. The old protectionist theory is the doctrine of trades unions as applied by the squires, and the modern trades unionism is the doctrine of the squires applied by the artisans. Why

should we be worse off under one *régime* than under the other?

Again, this sceptical minority asks the clergy to think whether it is really want of education which keeps the masses away from their ministrations–whether the most completely educated men are not as open to reproach on this score as the workmen; and whether, perchance, this may not indi[79]cate that it is not education which lies at the bottom of the matter?

Once more, these people, whom there is no pleasing, venture to doubt whether the glory which rests upon being able to undersell all the rest of the world, is a very safe kind of glory–whether we may not purchase it too dear; especially if we allow education, which ought to be directed to the making of men, to be diverted into a process of manufacturing human tools, wonderfully adroit in the exercise of some technical industry, but good for nothing else.

And, finally, these people inquire whether it is the masses alone who need a reformed and improved education. They ask whether the richest of our public schools might not well be made to supply knowledge, as well as gentlemanly habits, a strong class feeling, and eminent proficiency in cricket. They seem to think that the noble foundations of our old universities are hardly fulfilling their functions in their present posture of half-clerical seminaries, half racecourses, where men are trained to win a senior wranglership, or a double-first, as horses are trained to win a cup, with as little reference to the needs of after-life in the case of a man as in that of the racer. And, while as zealous for education as the rest, they affirm that, if the education of the richer classes were such as to fit them to be the leaders and the governors of the poorer; and, if the education of the [80] poorer classes were such as to enable them to appreciate really wise guidance and good governance, the politicians need not fear mob-law, nor the clergy lament their want of flocks, nor the capitalists prognosticate the annihilation of the prosperity of the country.

Such is the diversity of opinion upon the why and the wherefore of education. And my hearers will be prepared to expect that the practical recommendations which are put forward are not less discordant. There is a loud cry for compulsory education. We English, in spite of constant experience to the contrary, preserve a touching faith in the efficacy of acts of Parliament; and I believe we should have compulsory education in the course of next session, if there were the least probability that half a dozen leading statesmen of different parties would agree what that education should be.

Some hold that education without theology is worse than none. Others maintain, quite as strongly, that education with theology is in the same predicament. But this is certain, that those who hold the first opinion can by no means agree what theology should be taught; and that those who maintain the second are in a small minority.

At any rate "make people learn to read, write, and cipher," say a great many; and the advice is undoubtedly sensible as far as it goes. But, as has happened to me in former days, those who, in despair of getting anything better, advocate this [81] measure, are met with the objection that it is very like making a child practise the use of a knife, fork, and spoon, without giving it a particle of meat. I really

don't know what reply is to be made to such an objection.

But it would be unprofitable to spend more time in disentangling, or rather in showing up the knots in, the ravelled skeins of our neighbours. Much more to the purpose is it to ask if we possess any clue of our own which may guide us among these entanglements. And by way of a beginning, let us ask ourselves–What is education? Above all things, what is our ideal of a thoroughly liberal education?–of that education which, if we could begin life again, we would give ourselves–of that education which, if we could mould the fates to our own will, we would give our children? Well, I know not what may be your conceptions upon this matter, but I will tell you mine, and I hope I shall find that our views are not very discrepant.

Suppose it were perfectly certain that the life and fortune of every one of us would, one day or other, depend upon his winning or losing a game of chess. Don't you think that we should all consider it to be a primary duty to learn at least the names and the moves of the pieces; to have a notion of a gambit, and a keen eye for all the means of giving and getting out of check? Do [82] you not think that we should look with a disapprobation amounting to scorn, upon the father who allowed his son, or the state which allowed its members, to grow up without knowing a pawn from a knight?

Yet it is a very plain and elementary truth, that the life, the fortune, and the happiness of every one of us, and, more or less, of those who are connected with us, do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game which has been played for untold ages, every man and woman of us being one of the two players in a game of his or her own. The chess-board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The player on the other side is hidden from us. We know that his play is always fair, just and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with that sort of overflowing generosity with which the strong shows delight in strength. And one who plays ill is checkmated–without haste, but without remorse.

My metaphor will remind some of you of the famous picture in which Retzsch has depicted Satan playing at chess with man for his soul. Substitute for the mocking fiend in that [83] picture a calm, strong angel who is playing for love, as we say, and would rather lose than win–and I should accept it as an image of human life.

Well, what I mean by Education is learning the rules of this mighty game. In other words, education is the instruction of the intellect in the laws of Nature, under which name I include not merely things and their forces, but men and their ways; and the fashioning of the affections and of the will into an earnest and loving desire to move in harmony with those laws. For me, education means neither more nor less than this. Anything which professes to call itself education must be tried by this standard, and if it fails to stand the test, I will not call it education, whatever may be the force of authority, or of numbers, upon the other side.

It is important to remember that, in strictness, there is no such thing as an uneducated man. Take an extreme case. Suppose that an adult man, in the full vigour of his faculties, could be suddenly placed in the world, as Adam is said to have been, and then left to do as he best might. How long would he be left uneducated? Not five minutes. Nature would begin to teach him, through the eye, the ear, the touch, the properties of objects. Pain and pleasure would be at his elbow telling him to do this and avoid that; and by slow degrees the man would receive an education which, if narrow, would be thorough, real, [84] and adequate to his circumstances, though there would be no extras and very few accomplishments.

And if to this solitary man entered a second Adam, or, better still, an Eve, a new and greater world, that of social and moral phenomena, would be revealed. Joys and woes, compared with which all others might seem but faint shadows, would spring from the new relations. Happiness and sorrow would take the place of the coarser monitors, pleasure and pain; but conduct would still be shaped by the observation of the natural consequences of actions; or, in other words, by the laws of the nature of man.

To every one of us the world was once as fresh and new as to Adam. And then, long before we were susceptible of any other modes of instruction, Nature took us in hand, and every minute of waking life brought its educational influence, shaping our actions into rough accordance with Nature's laws, so that we might not be ended untimely by too gross disobedience. Nor should I speak of this process of education as past for any one, be he as old as he may. For every man the world is as fresh as it was at the first day, and as full of untold novelties for him who has the eyes to see them. And Nature is still continuing her patient education of us in that great university, the universe, of which we are all members–Nature having no Test-Acts.

[85] Those who take honours in Nature's university, who learn the laws which govern men and things and obey them, are the really great and successful men in this world. The great mass of mankind are the "Poll," who pick up just enough to go through without much discredit. Those who won't learn at all are plucked; and then you can't come up again. Nature's pluck means extermination.

Thus the question of compulsory education is settled so far as Nature is concerned. Her bill on that question was framed and passed a long ago. But, like all compulsory legislation, that of Nature is harsh and wasteful in its operation. Ignorance is visited as sharply as wilful disobedience–incapacity meets with the same punishment as crime. Nature's discipline is not even a word and a blow and the blow first; but the blow without the word. It is left to you to find out why your ears are boxed.

The object of what we commonly call education–that education in which man intervenes and which I shall distinguish as artificial education–to make good these defects in Nature's methods; to prepare the child to receive Nature's education neither incapably nor ignorantly, nor with wilful disobedience; and to understand the preliminary symptoms of her pleasure, without waiting for the box on the ear. In short, all artificial education ought to be an anticipation of natural education. And a liberal education is an artificial education [86] which has not only prepared a man to escape the great evils of disobedience to natural laws, but has trained him to appreciate and to seize upon the rewards, which Nature scatters with as free a hand as her penalties.

That man, I think, has had a liberal education who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of Nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of Nature or of art, to hate all vileness, and to respect others as himself.

Such an one and no other, I conceive, has had a liberal education; for he is, as completely as a man can be, in harmony with Nature. He will make the best of her, and she of him. They will get on together rarely; she as his ever beneficent mother; he as her mouthpiece, her conscious self, her minister and interpreter.

Where is such an education as this to be had? [87] Where is there any approximation to it? Has any one tried to found such an education? Looking over the length and breadth of these islands, I am afraid that all these questions must receive a negative answer. Consider our primary schools and what is taught in them. A child learns:–

1. To read, write, and cipher, more or less well; but in a very large proportion of cases not so well as to take pleasure in reading, or to be able to write the commonest letter properly.

2. A quantity of dogmatic theology, of which the child, nine times out of ten, understands next to nothing.

3. Mixed up with this, so as to seem to stand or fall with it, a few of the broadest and simplest principles of morality. This, to my mind, is much as if a man of science should make the story of the fall of the apple in Newton's garden an integral part of the doctrine of gravitation, and teach it as of equal authority with the law of the inverse squares.

4. A good deal of Jewish history and Syrian geography, and perhaps a little something about English history and the geography of the child's own country. But I doubt if there is a primary school in England in which hangs a map of the hundred in which the village lies, so that the children may be practically taught by it what a map means.

[88] 5. A certain amount of regularity, attentive obedience, respect for others: obtained by fear, if the master be incompetent or foolish; by love and reverence, if he be wise.

So far as this school course embraces a training in the theory and practice of obedience to the moral laws of Nature, I gladly admit, not only that it contains a valuable educational element, but that, so far, it deals with the most valuable and important part of all education. Yet, contrast what is done in this

direction with what might be done; with the time given to matters of comparatively no importance; with the absence of any attention to things of the highest moment; and one is tempted to think of Falstaff's bill and "the halfpenny worth of bread to all that quantity of sack."

Let us consider what a child thus "educated" knows, and what it does not know. Begin with the most important topic of all–morality, as the guide of conduct. The child knows well enough that some acts meet with approbation and some with disapprobation. But it has never heard that there lies in the nature of things a reason for every moral law, as cogent and as well defined as that which underlies every physical law; that stealing and lying are just as certain to be followed by evil consequences, as putting your hand in the fire, or jumping out of a garret window. Again, though the scholar may have been made acquainted, in [89] dogmatic fashion, with the broad laws of morality, he has had no training in the application of those laws to the difficult problems which result from the complex conditions of modern civilisation. Would it not be very hard to expect any one to solve a problem in conic sections who had merely been taught the axioms and definitions of mathematical science?

A workman has to bear hard labour, and perhaps privation, while he sees others rolling in wealth, and feeding their dogs with what would keep his children from starvation. Would it not be well to have helped that man to calm the natural promptings of discontent by showing him, in his youth, the necessary connection of the moral law which prohibits stealing with the stability of society–by proving to him, once for all, that it is better for his own people, better for himself, better for future generations, that he should starve than steal? If you have no foundation of knowledge, or habit of thought, to work upon, what chance have you of persuading a hungry man that a capitalist is not a thief "with a circumbendibus?" And if he honestly believes that, of what avail is it to quote the commandment against stealing, when he proposes to make the capitalist disgorge?

Again, the child learns absolutely nothing of the history or the political organisation of his own country. His general impression is, that everything of much importance happened a very long [90] while ago; and that the Queen and the gentlefolks govern the country much after the fashion of King David and the elders and nobles of Israel–his sole models. Will you give a man with this much information a vote? In easy times he sells it for a pot of beer. Why should he not? It is of about as much use to him as a chignon, and he knows as much what to do with it, for any other purpose. In bad times, on the contrary, he applies his simple theory of government, and believes that his rulers are the cause of his sufferings–a belief which sometimes bears remarkable practical fruits.

Least of all, does the child gather from this primary "education" of ours a conception of the laws of the physical world, or of the relations of cause and effect therein. And this is the more to be lamented, as the poor are especially exposed to physical evils, and are more interested in removing them than any other class of the community. If any one is concerned in knowing the ordinary laws of mechanics one would think it is the hand-labourer, whose daily toil lies among levers and pulleys; or among the other implements of artisan work. And if any one is interested in the laws of health, it is the poor workman, whose strength is wasted by ill-prepared food, whose health is sapped by bad ventilation and bad drainage, and half whose children are massacred by disorders which might be prevented. Not only does our present [91] primary education carefully abstain from hinting to the workman that some of his

greatest evils are traceable to mere physical agencies, which could be removed by energy, patience, and frugality; but it does worse–it renders him, so far as it can, deaf to those who could help him, and tries to substitute an Oriental submission to what is falsely declared to be the will of God, for his natural tendency to strive after a better condition.

What wonder, then, if very recently an appeal has been made to statistics for the profoundly foolish purpose of showing that education is of no good–that it diminishes neither misery nor crime among the masses of mankind? I reply, why should the thing which has been called education do either the one or the other? If I am a knave or a fool, teaching me to read and write won't make me less of either one or the other–unless somebody shows me how to put my reading and writing to wise and good purposes.

Suppose any one were to argue that medicine is of no use, because it could be proved statistically, that the percentage of deaths was just the same among people who had been taught how to open a medicine chest, and among those who did not so much as know the key by sight. The argument is absurd; but it is not more preposterous than that against which I am contending. The only medicine for suffering, crime, and all [92] the other woes of mankind, is wisdom. Teach a man to read and write, and you have put into his hands the great keys of the wisdom box. But it is quite another matter whether he ever opens the box or not. And he is as likely to poison as to cure himself, if, without guidance, he swallows the first drug that comes to hand. In these times a man may as well be purblind, as unable to read–lame, as unable to write. But I protest that, if I thought the alternative were a necessary one, I would rather that the children of the poor should grow up ignorant of both these mighty arts, than that they should remain ignorant of that knowledge to which these arts are means.

It may be said that all these animadversions may apply to primary schools, but that the higher schools, at any rate, must be allowed to give a liberal education. In fact they professedly sacrifice everything else to this object.

Let us inquire into this matter. What do the higher schools, those to which the great middle class of the country sends its children, teach, over and above the instruction given in the primary schools? There is a little more reading and writing of English. But, for all that, every one knows that it is a rare thing to find a boy of the middle or upper classes who can read aloud decently, or who can put his thoughts on paper in clear and grammatical (to say nothing of good or elegant) language. [93] The "ciphering" of the lower schools expands into elementary mathematics in the higher; into arithmetic, with a little algebra, a little Euclid. But I doubt if one boy in five hundred has ever heard the explanation of a rule of arithmetic, or knows his Euclid otherwise than by rote.

Of theology, the middle class schoolboy gets rather less than poorer children, less absolutely and less relatively, because there are so many other claims upon his attention. I venture to say that, in the great majority of cases, his ideas on this subject when he leaves school are of the most shadowy and vague description, and associated with painful impressions of the weary hours spent in learning collects and catechism by heart.

Modern geography, modern history, modern literature; the English language as a language; the whole circle of the sciences, physical, moral and social, are even more completely ignored in the higher than in the lower schools. Up till within a few years back, a boy might have passed through any one of the great public schools with the greatest distinction and credit, and might never so much as have heard of one of the subjects I have just mentioned. He might never have heard that the earth goes round the sun; that England underwent a great revolution in 1688, and France another in 1789; that there once lived certain notable men called Chaucer, Shakespeare, Milton, Voltaire, Goethe, Schiller. The first might [94] be a German and the last an Englishman for anything he could tell you to the contrary. And as for Science, the only idea the word would suggest to his mind would be dexterity in boxing.

I have said that this was the state of things a few years back, for the sake of the few righteous who are to be found among the educational cities of the plain. But I would not have you too sanguine about the result, if you sound the minds of the existing generation of public schoolboys, on such topics as those I have mentioned.

Now let us pause to consider this wonderful state of affairs; for the time will come when Englishmen will quote it as the stock example of the stolid stupidity of their ancestors in the nineteenth century. The most thoroughly commercial people, the greatest voluntary wanderers and colonists the world has ever seen, are precisely the middle class of this country. If there be a people which has been busy making history on the great scale for the last three hundred years–and the most profoundly interesting history–history which, if it happened to be that of Greece or Rome, we should study with avidity–it is the English. If there be a people which, during the same period, has developed a remarkable literature, it is our own. If there be a nation whose prosperity depends absolutely and wholly upon their mastery over the forces of Nature, upon their intelligent [95] apprehension of, and obedience to the laws of the creation and distribution of wealth, and of the stable equilibrium of the forces of society, it is precisely this nation. And yet this is what these wonderful people tell their sons:–"At the cost of from one to two thousand pounds of our hard-earned money, we devote twelve of the most precious years of your lives to school. There you shall toil, or be supposed to toil; but there you shall not learn one single thing of all those you will most want to know directly you leave school and enter upon the practical business of life. You will in all probability go into business, but you shall not know where, or how, any article of commerce is produced, or the difference between an export or an import, or the meaning of the word "capital." You will very likely settle in a colony, but you shall not know whether Tasmania is part of New South Wales, or *vice versâ*.

"Very probably you may become a manufacturer, but you shall not be provided with the means of understanding the working of one of your own steam-engines, or the nature of the raw products you employ; and, when you are asked to buy a patent, you shall not have the slightest means of judging whether the inventor is an impostor who is contravening the elementary principles of science, or a man who will make you as rich as Croesus.

"You will very likely get into the House of [96] Commons. You will have to take your share in making laws which may prove a blessing or a curse to millions of men. But you shall not hear one word respecting the political organisation of your country; the meaning of the controversy between free-

traders and protectionists shall never have been mentioned to you; you shall not so much as know that there are such things as economical laws.

"The mental power which will be of most importance in your daily life will be the power of seeing things as they are without regard to authority; and of drawing accurate general conclusions from particular facts. But at school and at college you shall know of no source of truth but authority; nor exercise your reasoning faculty upon anything but deduction from that which is laid down by authority.

"You will have to weary your soul with work, and many a time eat your bread in sorrow and in bitterness, and you shall not have learned to take refuge in the great source of pleasure without alloy, the serene resting-place for worn human nature,–the world of art."

Said I not rightly that we are a wonderful people? I am quite prepared to allow, that education entirely devoted to these omitted subjects might not be a completely liberal education. But is an education which ignores them all a liberal education? Nay, is it too much to say [97] that the education which should embrace these subjects and no others would be a real education, though an incomplete one; while an education which omits them is really not an education at all, but a more or less useful course of intellectual gymnastics?

For what does the middle-class school put in the place of all these things which are left out? It substitutes what is usually comprised under the compendious title of the "classics"–that is to say, the languages, the literature, and the history of the ancient Greeks and Romans, and the geography of so much of the world as was known to these two great nations of antiquity. Now, do not expect me to depreciate the earnest and enlightened pursuit of classical learning. I have not the least desire to speak ill of such occupations, nor any sympathy with them who run them down. On the contrary, if my opportunities had lain in that direction, there is no investigation into which I could have thrown myself with greater delight than that of antiquity.

What science can present greater attractions than philology? How can a lover of literary excellence fail to rejoice in the ancient masterpieces? And with what consistency could I, whose business lies so much in the attempt to decipher the past, and to build up intelligible forms out of the scattered fragments of long-extinct beings, fail to take a sympathetic, though an [98] unlearned, interest in the labours of a Niebuhr, a Gibbon, or a Grote? Classical history is a great section of the palæontology of man; and I have the same double respect for it as for other kinds of paleontology–that is to say, a respect for the facts which it establishes as for all facts, and a still greater respect for it as a preparation for the discovery of a law of progress.

But if the classics were taught as they might be taught–if boys and girls were instructed in Greek and Latin, not merely as languages, but as illustrations of philological science; if a vivid picture of life on the shores of the Mediterranean two thousand years ago were imprinted on the minds of scholars; if ancient history were taught, not as a weary series of feuds and fights, but traced to its causes in such men placed under such conditions; if, lastly, the study of the classical books were followed in such a manner as to

impress boys with their beauties, and with the grand simplicity of their statement of the everlasting problems of human life, instead of with their verbal and grammatical peculiarities; I still think it as little proper that they should form the basis of a liberal education for our contemporaries, as I should think it fitting to make that sort of palæontology with which I am familiar the back-bone of modern education.

It is wonderful how close a parallel to classical training could be made out of that palæontology [99] to which I refer. In the first place I could get up an osteological primer so arid, so pedantic in its terminology, so altogether distasteful to the youthful mind, as to beat the recent famous production of the head-masters out of the field in all these excellences. Next, I could exercise my boys upon easy fossils, and bring out all their powers of memory and all their ingenuity in the application of my osteo-grammatical rules to the interpretation, or construing, of those fragments. To those who had reached the higher classes, I might supply odd bones to be built up into animals, giving great honour and reward to him who succeeded in fabricating monsters most entirely in accordance with the rules. That would answer to verse-making and essay-writing in the dead languages.

To be sure, if a great comparative anatomist were to look at these fabrications he might shake his head, or laugh. But what then? Would such a catastrophe destroy the parallel? What, think you, would Cicero, or Horace, say to the production of the best sixth form going? And would not Terence stop his ears and run out if he could be present at an English performance of his own plays? Would *Hamlet*, in the mouths of a set of French actors, who should insist on pronouncing English after the fashion of their own tongue, be more hideously ridiculous?

But it will be said that I am forgetting the beauty, and the human interest, which appertain [100] to classical studies. To this I reply that it is only a very strong man who can appreciate the charms of a landscape as he is toiling up a steep hill, along a bad road. What with short-windedness, stones, ruts, and a pervading sense of the wisdom of rest and be thankful, most of us have little enough sense of the beautiful under these circumstances. The ordinary schoolboy is precisely in this case. He finds Parnassus uncommonly steep, and there is no chance of his having much time or inclination to look about him till he gets to the top. And nine times out of ten he does not get to the top.

But if this be a fair picture of the results of classical teaching at its best–and I gather from those who have authority to speak on such matters that it is so–what is to be said of classical teaching at its worst, or in other words, of the classics of our ordinary middle-class schools?[1] I will tell you. It means getting up endless forms and rules by heart. It means turning Latin and Greek into English, for the mere sake of being able to do it, and without the smallest regard to the worth, or worthlessness, of the author read. It means the learning of innumerable, not always decent, fables in such a shape that the meaning they once had is dried up into utter trash; and the only impression left upon a boy's mind is, that the people who believed such [101] things must have been the greatest idiots the world ever saw. And it means, finally, that after a dozen years spent at this kind of work, the sufferer shall be incompetent to interpret a passage in an author he has not already got up; that he shall loathe the sight of a Greek or Latin book; and that he shall never open, or think of, a classical writer again, until, wonderful to relate, he insists upon submitting his sons to the same process.

These be your gods, O Israel! For the sake of this net result (and respectability) the British father denies his children all the knowledge they might turn to account in life, not merely for the achievement of vulgar success, but for guidance in the great crises of human existence. This is the stone he offers to those whom he is bound by the strongest and tenderest ties to feed with bread.

If primary and secondary education are in this unsatisfactory state, what is to be said to the universities? This is an awful subject, and one I almost fear to touch with my unhallowed hands; but I can tell you what those say who have authority to speak.

The Rector of Lincoln College, in his lately published valuable "Suggestions for Academical Organisation with especial reference to Oxford," tells us (p. 127):–

"The colleges were, in their origin, endow[102]ments, not for the elements of a general liberal education, but for the prolonged study of special and professional faculties by men of riper age. The universities embraced both these objects. The colleges, while they incidentally aided in elementary education, were specially devoted to the highest learning . . .

"This was the theory of the middle-age university and the design of collegiate foundations in their origin. Time and circumstances have brought about a total change. The colleges no longer promote the researches of science, or direct professional study. Here and there college walls may shelter an occasional student, but not in larger proportions than may be found in private life. Elementary teaching of youths under twenty is now the only function performed by the university, and almost the only object of college endowments. Colleges were homes for the life-study of the highest and most abstruse parts of knowledge. They have become boarding schools in which the elements of the learned languages are taught to youths."

If Mr. Pattison's high position, and his obvious love and respect for his university, be insufficient to convince the outside world that language so severe is yet no more than just, the authority of the Commissioners who reported on the University of Oxford in 1850 is open to no challenge. Yet they write:–

[103] "It is generally acknowledged that both Oxford and the country at large suffer greatly from the absence of a body of learned men devoting their lives to the cultivation of science, and to the direction of academical education.

"The fact that so few books of profound research emanate from the University of Oxford, materially impairs its character as a seat of learning, and consequently its hold on the respect of the nation."

Cambridge can claim no exemption from the reproaches addressed to Oxford. And thus there seems no escape from the admission that what we fondly call our great seats of learning are simply "boarding schools" for bigger boys; that learned men are not more numerous in them than out of them; that the advancement of knowledge is not the object of fellows of colleges; that, in the philosophic calm and

meditative stillness of their greenswarded courts, philosophy does not thrive, and meditation bears few fruits.

It is my great good fortune to reckon amongst my friends resident members of both universities, who are men of learning and research, zealous cultivators of science, keeping before their minds a noble ideal of a university, and doing their best to make that ideal a reality; and, to me, they would necessarily typify the universities, did not the authoritative statements I have quoted compel me to believe that they are exceptional, [104] and not representative men. Indeed, upon calm consideration, several circumstances lead me to think that the Rector of Lincoln College and the Commissioners cannot be far wrong.

I believe there can be no doubt that the foreigner who should wish to become acquainted with the scientific, or the literary, activity of modern England, would simply lose his time and his pains if he visited our universities with that object.

And, as for works of profound research on any subject, and, above all, in that classical lore for which the universities profess to sacrifice almost everything else, why, a third-rate, poverty-stricken German university turns out more produce of that kind in one year, than our vast and wealthy foundations elaborate in ten.

Ask the man who is investigating any question, profoundly and thoroughly–be it historical, philosophical, philological, physical, literary, or theological; who is trying to make himself master of any abstract subject (except, perhaps, political economy and geology, both of which are intensely Anglican sciences), whether he is not compelled to read half a dozen times as many German as English books? And whether, of these English books, more than one in ten is the work of a fellow of a college, or a professor of an English university?

Is this from any lack of power in the English [105] as compared with the German mind? The countrymen of Grote and of Mill, of Faraday, of Robert Brown, of Lyell, and of Darwin, to go no further back than the contemporaries of men of middle age, can afford to smile at such a suggestion. England can show now, as she has been able to show in every generation since civilisation spread over the West, individual men who hold their own against the world, and keep alive the old tradition of her intellectual eminence.

But, in the majority of cases, these men are what they are in virtue of their native intellectual force, and of a strength of character which will not recognise impediments. They are not trained in the courts of the Temple of Science, but storm the walls of that edifice in all sorts of irregular ways, and with much loss of time and power, in order to obtain their legitimate positions.

Our universities not only do not encourage such men; do not offer them positions, in which it should be their highest duty to do, thoroughly, that which they are most capable of doing; but, as far as possible, university training shuts out of the minds of those among them, who are subjected to it, the prospect that there is anything in the world for which they are specially fitted. Imagine the success of the attempt to

still the intellectual hunger of any of the men I have mentioned, by putting before him, as the object of existence, the successful mimicry of the measure of a Greek [106] song, or the roll of Ciceronian prose! Imagine how much success would be likely to attend the attempt to persuade such men that the education which leads to perfection in such elegances is alone to be called culture; while the facts of history, the process of thought, the conditions of moral and social existence, and the laws of physical nature are left to be dealt with as they may by outside barbarians!

It is not thus that the German universities from being beneath notice a century ago, have become what they are now–the most intensely cultivated and the most productive intellectual corporations the world has ever seen.

The student who repairs to them sees in the list of classes and of professors a fair picture of the world of knowledge. Whatever he needs to know there is some one ready to teach him, some one competent to discipline him in the way of learning; whatever his special bent, let him but be able and diligent, and in due time he shall find distinction and a career. Among his professors, he sees men whose names are known and revered throughout the civilised world; and their living example infects him with a noble ambition, and a love for the spirit of work.

The Germans dominate the intellectual world by virtue of the same simple secret as that which made Napoleon the master of old Europe. They have declared *la carriére ouverte aux talents,* and [107] every Bursch marches with a professor's gown in his knapsack. Let him become a great scholar, or man of science, and ministers will compete for his services. In Germany, they do not leave the chance of his holding the office he would render illustrious to the tender mercies of a hot canvass, and the final wisdom of a mob of country parsons.

In short, in Germany, the universities are exactly what the Rector of Lincoln and the Commissioners tell us the English universities are not; that is to say, corporations "of learned men devoting their lives to the cultivation of science, and the direction of academical education." They are not "boarding schools for youths," nor clerical seminaries; but institutions for the higher culture of men, in which the theological faculty is of no more importance or prominence, than the rest; and which are truly "universities," since they strive to represent and embody the totality of human knowledge, and to find room for all forms of intellectual activity.

May zealous and clear-headed reformers like Mr. Pattison succeed in their noble endeavours to shape our universities towards some such ideal as this, without losing what is valuable and distinctive in their social tone! But until they have succeeded, a liberal education will be no more obtainable in our Oxford and Cambridge Universities than in our public schools.

[108] If I am justified in my conception of the ideal of a liberal education; and if what I have said about the existing educational institutions of the country is also true, it is clear that the two have no sort of relation to one another; that the best of our schools and the most complete of our university trainings give but a narrow, one-sided, and essentially illiberal education–while the worst give what is really next

to no education at all. The South London Working-Men's College could not copy any of these institutions if it would; I am bold enough to express the conviction that it ought not if it could.

For what is wanted is the reality and not the mere name of a liberal education; and this College must steadily set before itself the ambition to be able to give that education sooner or later. At present we are but beginning, sharpening our educational tools, as it were, and, except a modicum of physical science, we are not able to offer much more than is to be found in an ordinary school.

Moral and social science–one of the greatest and most fruitful of our future classes, I hope–at present lacks only one thing in our programme, and that is a teacher. A considerable want, no doubt; but it must be recollected that it is much better to want a teacher than to want the desire to learn.

Further, we need what, for want of a better [109] name, I must call Physical Geography. What I mean is that which the Germans call *"Erdkunde."* It is a description of the earth, of its place and relation to other bodies; of its general structure, and of its great features–winds, tides, mountains, plains: of the chief forms of the vegetable and animal worlds, of the varieties of man. It is the peg upon which the greatest quantity of useful and entertaining scientific information can be suspended.

Literature is not upon the College programme; but I hope some day to see it there. For literature is the greatest of all sources of refined pleasure, and one of the great uses of a liberal education is to enable us to enjoy that pleasure. There is scope enough for the purposes of liberal education in the study of the rich treasures of our own language alone. All that is needed is direction, and the cultivation of a refined taste by attention to sound criticism. But there is no reason why French and German should not be mastered sufficiently to read what is worth reading in those languages with pleasure and with profit.

And finally, by and by, we must have History; treated not as a succession of battles and dynasties; not as a series of biographies; not as evidence that Providence has always been on the side of either Whigs or Tories; but as the development of man in times past, and in other conditions than our own.

[110] But, as it is one of the principles of our College to be self-supporting, the public must lead, and we must follow, in these matters. If my hearers take to heart what I have said about liberal education, they will desire these things, and I doubt not we shall be able to supply them. But we must wait till the demand is made.

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[1] For a justification of what is here said about these schools, see that valuable book, *Essays on a Liberal Education, passim.*

T. H. H. and Blackboard friend

Wellcome Museum

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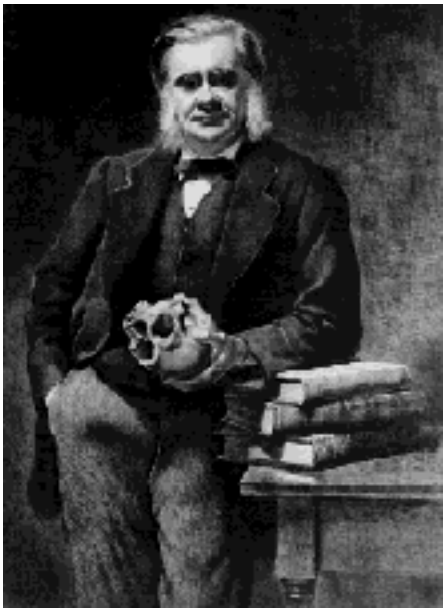

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C. Blinderman & D. Joyce
Clark University

"Portrait of a Gentleman"

"If he only knew what his examiner was doing!
Portrait of a gentleman just opposite me.
N.B. He can't stand it any more & has just gone out."
Huxley Archives

Scientific Education: Notes of an After-Dinner Speech (1869)

Collected Essays III

[111] [Mr. Thackeray, talking of after-dinner speeches, has lamented that "one never can recollect the fine things one thought of in the cab," in going to the place of entertainment. I am not aware that there are any "fine things" in the following pages, but such as there are stand to a speech which really did get itself spoken, at the hospitable table of the Liverpool Philomathic

Society, more or less in the position of what "one thought of in the cab."]

The introduction of scientific training into the general education of the country is a topic upon which I could not have spoken, without some more or less apologetic introduction, a few years ago. But upon this, as upon other matters, public opinion has of late undergone a rapid modification. Committees of both Houses of the Legislature have agreed that something must be done in this direc[112]tion, and have even thrown out timid and faltering suggestions as to what should be done; while at the opposite pole of society, committees of working men have expressed their conviction that scientific training is the one thing needful for their advancement, whether as men, or as workmen. Only the other day, it was my duty to take part in the reception of a deputation of London working men, who desired to learn from Sir Roderick Murchison, the Director of the Royal School of Mines, whether the organisation of the Institution in Jermyn Street could be made available for the supply of that scientific instruction the need of which could not have been apprehended, or stated, more clearly than it was by them.

The heads of colleges in our great universities (who have not the reputation of being the most mobile of persons) have, in several cases, thought it well that, out of the great number of honours and rewards at their disposal, a few should hereafter be given to the cultivators of the physical sciences. Nay, I hear that some colleges have even gone so far as to appoint one, or, maybe, two special tutors for the purpose of putting the facts and principles of physical science before the undergraduate mind. And I say it with gratitude and great respect for those eminent persons, that the head masters of our public schools, Eton, Harrow, Winchester, have addressed themselves to the problem of introducing instruction in physical [113] science among the studies of those great educational bodies, with much honesty of purpose and enlightenment of understanding; and I live in hope that, before long, important changes in this direction will be carried into effect in those strongholds of ancient prescription. In fact, such changes have already been made, and physical science, even now, constitutes a recognised element of the school curriculum in Harrow and Rugby, whilst I understand that ample preparations for such studies are being made at Eton and elsewhere.

Looking at these facts, I might perhaps spare myself the trouble of giving any reasons for the introduction of physical science into elementary education; yet I cannot but think that it may be well if I place before you some considerations which, perhaps, have hardly received full attention.

At other times, and in other places, I have endeavoured to state the higher and more abstract arguments, by which the study of physical science may be shown to be indispensable to the complete training of the human mind; but I do not wish it to be supposed that, because I happen to be devoted to more or less abstract and "unpractical" pursuits, I am insensible to the weight which ought to be attached to that which has been said to be the English conception of Paradise–namely, "getting on." I look upon it, that "getting on" is a very important matter indeed. I do not mean [114] merely for the sake of the coarse and tangible results of success, but because humanity is so constituted that a vast number of us would never be impelled to those stretches of exertion which make us wiser and more capable men, if it were not for the absolute necessity of putting on our faculties all the strain they will bear, for the purpose of "getting on" in the most practical sense.

Now the value of a knowledge of physical science as a means of getting on is indubitable. There are hardly any of our trades, except the merely huckstering ones, in which some knowledge of science may not be directly profitable to the pursuer of that occupation. As industry attains higher stages of its development, as its processes become more complicated and refined, and competition more keen, the sciences are dragged in, one by one, to take their share in the fray; and he who can best avail himself of their help is the man who will come out uppermost in that struggle for existence, which goes on as fiercely beneath the smooth surface of modern society, as among the wild inhabitants of the woods.

But in addition to the bearing of science on ordinary practical life, let me direct your attention to its immense influence on several of the professions. I ask any one who has adopted the calling of an engineer, how much time he lost when he left school, because he had to devote himself to pursuits which were absolutely novel and strange, [115] and of which he had not obtained the remotest conception from his instructors? He had to familiarise himself with ideas of the course and powers of Nature, to which his attention had never been directed during his school life, and to learn, for the first time, that a world of facts lies outside and beyond the world of words. I appeal to those who know what engineering is, to say how far I am right in respect to that profession; but with regard to another, of no less importance, I shall venture to speak of my own knowledge. There is no one of us who may not at any moment be thrown, bound hand and foot by physical incapacity, into the hands of a medical practitioner. The chances of life and death for all and each of us may, at any moment, depend on the skill with which that practitioner is able to make out what is wrong in our bodily frames, and on his ability to apply the proper remedy to the defect.

The necessities of modern life are such, and the class from which the medical profession is chiefly recruited is so situated, that few medical men can hope to spend more than three or four, or it may be five, years in the pursuit of those studies which are immediately germane to physic. How is that all too brief period spent at present? I speak as an old examiner, having served some eleven or twelve years in that capacity in the University of London, and therefore having a practical acquaintance with the subject; but I might fortify myself by the [116] authority of the President of the College of Surgeons, Mr. Quain, whom I heard the other day in an admirable address (the Hunterian Oration) deal fully and wisely with this very topic.[1]

A young man commencing the study of medicine is at once required to endeavour to make an acquaintance with a number of sciences, such as Physics, as Chemistry, as Botany, as Physiology, which are absolutely and entirely strange to him, however excellent his so-called education at school may have been. Not only is he devoid of all apprehension of scientific conceptions, not only does he fail to attach any meaning to the words "mat[117]ter," "force," or "law" in their scientific senses, but, worse still, he has no notion of what it is to come into contact with Nature, or to lay his mind alongside of a physical fact, and try to conquer it, in the way our great naval hero told his captains to master their enemies. His whole mind has been given to books, and I am hardly exaggerating if I say that they are more real to him than Nature. He imagines that all knowledge can be got out of books, and rests upon the authority of some master or other; nor does he entertain any misgiving that the method of learning which led to proficiency in the rules of grammar will suffice to lead him to a mastery of the laws of Nature. The

youngster, thus unprepared for serious study, is turned loose among his medical studies, with the result, in nine cases out of ten, that the first year of his curriculum is spent in learning how to learn. Indeed, he is lucky if, at the end of the first year, by the exertions of his teachers and his own industry, he has acquired even that art of arts. After which there remain not more than three, or perhaps four, years for the profitable study of such vast sciences as Anatomy, Physiology, Therapeutics, Medicine, Surgery, Obstetrics, and the like, upon his knowledge or ignorance of which it depends whether the practitioner shall diminish, or increase, the bills of mortality. Now what is it but the preposterous condition of ordinary school education which prevents a young man of seventeen, destined for the [118] practice of medicine, from being fully prepared for the study of Nature; and from coming to the medical school, equipped with that preliminary knowledge of the principles of Physics, of Chemistry and of Biology, upon which he has now to waste one of the precious years, every moment of which ought to be given to those studies which bear directly upon the knowledge of his profession?

There is another profession, to the members of which, I think, a certain preliminary knowledge of physical science might be quite as valuable as to the medical man. The practitioner of medicine sets before himself the noble object of taking care of man's bodily welfare; but the members of this other profession undertake to "minister to minds diseased," and, so far as may be, to diminish sin and soften sorrow. Like the medical profession, the clerical, of which I now speak, rests its power to heal upon its knowledge of the order of the universe–upon certain theories of man's relation to that which lies outside him. It is not my business to express any opinion about these theories. I merely wish to point out that, like all other theories, they are professedly based upon matters of fact. Thus the clerical profession has to deal with the facts of Nature from a certain point of view; and hence it comes into contact with that of the man of science, who has to treat the same facts from another point of view. You know how [119] often that contact is to be described as collision, or violent friction; and how great the heat, how little the light, which commonly results from it.

In the interests of fair play, to say nothing of those of mankind, I ask, Why do not the clergy as a body acquire, as a part of their preliminary education, some such tincture of physical science as will put them in a position to understand the difficulties in the way of accepting their theories, which are forced upon the mind of every thoughtful and intelligent man, who has taken the trouble to instruct himself in the elements of natural knowledge?

Some time ago I attended a large meeting of the clergy, for the purpose of delivering an address which I had been invited to give. I spoke of some of the most elementary facts in physical science, and of the manner in which they directly contradict certain of the ordinary teachings of the clergy. The result was, that, after I had finished, one section of the assembled ecclesiastics attacked me with all the intemperance of pious zeal, for stating facts and conclusions which no competent judge doubts; while, after the first speakers had subsided, amidst the cheers of the great majority of their colleagues, the more rational minority rose to tell me that I had taken wholly superfluous pains, that they already knew all about what I had told them, and perfectly agreed with me. A hard-headed friend of mine, who was present, put the not un[120]natural question, "Then why don't you say so in your pulpits?" to which inquiry I heard no reply.

In fact the clergy are at present divisible into three sections: an immense body who are ignorant and speak out; a small proportion who know and are silent; and a minute minority who know and speak according to their knowledge. By the clergy, I mean especially the Protestant clergy. Our great antagonist–I speak as a man of science–the Roman Catholic Church, the one great spiritual organisation which is able to resist, and must, as a matter of life and death, resist, the progress of science and modern civilisation, manages her affairs much better.

It was my fortune some time ago to pay a visit to one of the most important of the institutions in which the clergy of the Roman Catholic Church in these islands are trained; and it seemed to me that the difference between these men and the comfortable champions of Anglicanism and of Dissent, was comparable to the difference between our gallant Volunteers and the trained veterans of Napoleon's Old Guard.

The Catholic priest is trained to know his business, and do it effectually. The professors of the college in question, learned, zealous, and determined men, permitted me to speak frankly with them. We talked like outposts of opposed armies during a truce–as friendly enemies; and [121] when I ventured to point out the difficulties their students would have to encounter from scientific thought, they replied: "Our Church has lasted many ages, and has passed safely through many storms. The present is but a new gust of the old tempest, and we do not turn out our young men less fitted to weather it, than they have been, in former times, to cope with the difficulties of those times. The heresies of the day are explained to them by their professors of philosophy and science, and they are taught how those heresies are to be met."

I heartily respect an organisation which faces its enemies in this way; and I wish that all ecclesiastical organisations were in as effective a condition. I think it would be better, not only for them, but for us. The army of liberal thought is, at present, in very loose order; and many a spirited free-thinker makes use of his freedom mainly to vent nonsense. We should be the better for a vigorous and watchful enemy to hammer us into cohesion and discipline; and I, for one, lament that the bench of Bishops cannot show a man of the calibre of Butler of the "Analogy," who, if he were alive, would make short work of much of the current *a priori* "infidelity."

I hope you will consider that the arguments I have now stated, even if there were no better ones, constitute a sufficient apology for urging the introduction of science into schools. [122] The next question to which I have to address myself is, What sciences ought to be thus taught? And this is one of the most important of questions, because my side (I am afraid I am a terribly candid friend) sometimes spoils its cause by going in for too much. There are other forms of culture beside physical science; and I should be profoundly sorry to see the fact forgotten, or even to observe a tendency to starve, or cripple, literary, or æsthetic, culture for the sake of science. Such a narrow view of the nature of education has nothing to do with my firm conviction that a complete and thorough scientific culture ought to be introduced into all schools. By this, however, I do not mean that every schoolboy should be taught everything in science. That would be a very absurd thing to conceive, and a very mischievous thing to attempt. What I mean is, that no boy nor girl should leave school without possessing a grasp of the general character of science, and without having been disciplined, more or less, in the methods of all

sciences; so that, when turned into the world to make their own way, they shall be prepared to face scientific problems, not by knowing at once the conditions of every problem, or by being able at once to solve it; but by being familiar with the general current of scientific thought, and by being able to apply the methods of science in the proper way, when they have acquainted themselves with the conditions of the special problem.

[123] That is what I understand by scientific education. To furnish a boy with such an education, it is by no means necessary that he should devote his whole school existence to physical science: in fact, no one would lament so one-sided a proceeding more than I. Nay more, it is not necessary for him to give up more than a moderate share of his time to such studies, if they be properly selected and arranged, and if he be trained in them in a fitting manner.

I conceive the proper course to be somewhat as follows. To begin with, let every child be instructed in those general views of the phænomena of Nature for which we have no exact English name. The nearest approximation to a name for what I mean, which we possess, is "physical geography." The Germans have a better, "Erdkunde" ("earth knowledge" or "geology" in its etymological sense), that is to say, a general knowledge of the earth, and what is on it, in it, and about it. If any one who has had experience of the ways of young children will call to mind their questions, he will find that so far as they can be put into any scientific category, they come under this head of "Erdkunde." The child asks, "What is the moon, and why does it shine?" "What is this water, and where does it run?" "What is the wind?" "What makes this waves [sic] in the sea?" "Where does this animal live, and what is the use of that plant?" And [124] if not snubbed and stunted by being told not to ask foolish questions, there is no limit to the intellectual craving of a young child; nor any bounds to the slow, but solid, accretion of knowledge and development of the thinking faculty in this way. To all such questions, answers which are necessarily incomplete, though true as far as they go, may be given by any teacher whose ideas represent real knowledge and not mere book learning; and a panoramic view of Nature, accompanied by a strong infusion of the scientific habit of mind, may thus be placed within the reach of every child of nine or ten.

After this preliminary opening of the eyes to the great spectacle of the daily progress of Nature, as the reasoning faculties of the child grow, and he becomes familiar with the use of the tools of knowledge–reading, writing, and elementary mathematics–he should pass on to what is, in the more strict sense, physical science. Now there are two kinds of physical science: the one regards form and the relation of forms to one another; the other deals with causes and effects. In many of what we term sciences, these two kinds are mixed up together; but systematic botany is a pure example of the former kind, and physics of the latter kind, of science. Every educational advantage which training in physical science can give is obtainable from the proper study of these two; and I should be contented, [125] for the present, if they, added to our "Erdkunde," furnished the whole of the scientific curriculum of school. Indeed, I conceive it would be one of the greatest boons which could be conferred upon England, if henceforward every child in the country were instructed in the general knowledge of the things about it, in the elements of physics, and of botany. But I should be still better pleased if there could be added somewhat of chemistry, and an elementary acquaintance with human physiology.

So far as school education is concerned, I want to go no further just now; and I believe that such instruction would make an excellent introduction to that preparatory scientific training which, as I have indicated, is so essential for the successful pursuit of our most important professions But this modicum of instruction must be so given as to ensure real knowledge and practical discipline. If scientific education is to be dealt with as mere bookwork, it will be better not to attempt it, but to stick to the Latin Grammar which makes no pretence to be anything but bookwork.

If the great benefits of scientific training are sought, it is essential that such training should be real: that is to say, that the mind of the scholar should be brought into direct relation with fact, that he should not merely be told a thing, but made to see by the use of his own intellect and [126] ability that the thing is so and no otherwise. The great peculiarity of scientific training, that in virtue of which it cannot be replaced by any other discipline whatsoever, is this bringing of the mind directly into contact with fact, and practising the intellect in the completest form of induction; that is to say, in drawing conclusions from particular facts made known by immediate observation of Nature.

The other studies which enter into ordinary education do not discipline the mind in this way. Mathematical training is almost purely deductive. The mathematician starts with a few simple propositions, the proof of which is so obvious that they are called self-evident, and the rest of his work consists of subtle deductions from them. The teaching of languages, at any rate as ordinarily practised, is of the same general nature,–authority and tradition furnish the data, and the mental operations of the scholar are deductive.

Again: if history be the subject of study, the facts are still taken upon the evidence of tradition and authority. You cannot make a boy see the battle of Thermopylæ for himself, or know, of his own knowledge, that Cromwell once ruled England. There is no getting into direct contact with natural fact by this road; there is no dispensing with authority, but rather a resting upon it.

In all these respects, science differs from other educational discipline, and prepares the scholar for [127] common life. What have we to do in every-day life? Most of the business which demands our attention is matter of fact, which needs, in the first place, to be accurately observed or apprehended; in the second, to be interpreted by inductive and deductive reasonings, which are altogether similar in their nature to those employed in science. In the one case, as in the other, whatever is taken for granted is so taken at one's own peril; fact and reason are the ultimate arbiters, and patience and honesty are the great helpers out of difficulty.

But if scientific training is to yield its most eminent results, it must, I repeat, be made practical. That is to say, in explaining to a child the general phænomena of Nature, you must, as far as possible, give reality to your teaching by object-lessons; in teaching him botany, he must handle the plants and dissect the flowers for himself; in teaching him physics and chemistry, you must not be solicitous to fill him with information, but you must be careful that what he learns he knows of his own knowledge. Don't be satisfied with telling him that a magnet attracts iron. Let him see that it does; let him feel the pull of the one upon the other for himself. And, especially, tell him that it is his duty to doubt until he is compelled,

by the absolute authority of Nature, to believe that which is written in books. Pursue this discipline carefully and conscientiously, and you may make sure that, however scanty may be the measure of [128] information which you have poured into the boy's mind, you have created an intellectual habit of priceless value in practical life.

One is constantly asked, When should this scientific education be commenced? I should say with the dawn of intelligence. As I have already said, a child seeks for information about matters of physical science as soon as it begins to talk. The first teaching it wants is an object-lesson of one sort or another; and as soon as it is fit for systematic instruction of any kind, it is fit for a modicum of science.

People talk of the difficulty of teaching young children such matters, and in the same breath insist upon their learning their Catechism, which contains propositions far harder to comprehend than anything in the educational course I have proposed. Again: I am incessantly told that we, who advocate the introduction of science in schools, make no allowance for the stupidity of the average boy or girl; but, in my belief, that stupidity, in nine cases out of ten, "*fit, non nascitur*," and is developed by a long process of parental and pedagogic repression of the natural intellectual appetites, accompanied by a persistent attempt to create artificial ones for food which is not only tasteless, but essentially indigestible.

Those who urge the difficulty of instructing young people in science are apt to forget another very important condition of success–important in [129] all kinds of teaching, but most essential, I am disposed to think, when the scholars are very young. This condition is, that the teacher should himself really and practically know his subject. If he does, he will be able to speak of it in the easy language, and with the completeness of conviction, with which he talks of any ordinary every-day matter. If he does not, he will be afraid to wander beyond the limits of the technical phraseology which he has got up; and a dead dogmatism, which oppresses, or raises opposition, will take the place of the lively confidence, born of personal conviction, which cheers and encourages the eminently sympathetic mind of childhood.

I have already hinted that such scientific training as we seek for may be given without making any extravagant claim upon the time now devoted to education. We ask only for "a most favoured nation" clause in our treaty with the schoolmaster; we demand no more than that science shall have as much time given to it as any other single subject–say four hours a week in each class of an ordinary school.

For the present, I think men of science would be well content with such an arrangement as this; but speaking for myself, I do not pretend to believe that such an arrangement can be, or will be, permanent. In these times the educational tree seems to me to have its roots in the air, its leaves and flowers in the ground; and, I confess, I should [130] very much like to turn it upside down, so that its roots might be solidly embedded among the facts of Nature, and draw thence a sound nutriment for the foliage and fruit of literature and of art. No educational system can have a claim to permanence, unless it recognises the truth that education has two great ends to which everything else must be subordinated. The one of these is to increase knowledge; the other is to develop the love of right and the hatred of wrong.

With wisdom and uprightness a nation can make its way worthily, and beauty will follow in the

footsteps of the two, even if she be not specially invited; while there is perhaps no sight in the whole world more saddening and revolting than is offered by men sunk in ignorance of everything but what other men have written; seemingly devoid of moral belief or guidance; but with the sense of beauty so keen, and the power of expression so cultivated, that their sensual caterwauling may be almost mistaken for the music of the spheres.

At present, education is almost entirely devoted to the cultivation of the power of expression, and of the sense of literary beauty. The matter of having anything to say, beyond a hash of other people's opinions, or of possessing any criterion of beauty, so that we may distinguish between the Godlike and the devilish, is left aside as of no moment. I think I do not err in saying that if science were made a foundation of education, [131] instead of being, at most, stuck on as cornice to the edifice, this state of things could not exist.

In advocating the introduction of physical science as a leading element in education, I by no means refer only to the higher schools. On the contrary, I believe that such a change is even more imperatively called for in those primary schools, in which the children of the poor are expected to turn to the best account the little time they can devote to the acquisition of knowledge. A great step in this direction has already been made by the establishment of science-classes under the Department of Science and Art,–a measure which came into existence unnoticed, but which will, I believe, turn out to be of more importance to the welfare of the people than many political changes over which the noise of battle has rent the air.

Under the regulations to which I refer, a schoolmaster can set up a class in one or more branches of science; his pupils will be examined, and the State will pay him, at a certain rate, for all who succeed in passing. I have acted as an examiner under this system from the beginning of its establishment, and this year I expect to have not fewer than a couple of thousand sets of answers to questions in Physiology, mainly from young people of the artisan class, who have been taught in the schools which are now scattered all over great Britain and Ireland. Some of my colleagues, who have to deal with subjects such as [132] Geometry, for which the present teaching power is better organised, I understand are likely to have three or four times as many papers. So far as my own subjects are concerned, I can undertake to say that a great deal of the teaching, the results of which are before me in these examinations, is very sound and good; and I think it is in the power of the examiners, not only to keep up the present standard, but to cause an almost unlimited improvement. Now what does this mean? It means that by holding out a very moderate inducement, the masters of primary schools in many parts of the country have been led to convert them into little foci of scientific instruction; and that they and their pupils have contrived to find, or to make, time enough to carry out this object with a very considerable degree of efficiency. That efficiency will, I doubt not, be very much increased as the system becomes known and perfected, even with the very limited leisure left to masters and teachers on week-days. And this leads me to ask, Why should scientific teaching be limited to week-days?

Ecclesiastically-minded persons are in the habit of calling things they do not like by very hard names, and I should not wonder if they brand the proposition I am about to make as blasphemous, and worse. But, not minding this, I venture to ask, Would there really be anything wrong in using part of Sunday for the purpose of instructing [133] those who have no other leisure, in a knowledge of the phænomena of

Nature, and of man's relation to Nature?

I should like to see a scientific Sunday-school in every parish, not for the purpose of superseding any existing means of teaching the people the things that are for their good, but side by side with them. I cannot but think that there is room for all of us to work in helping to bridge over the great abyss of ignorance which lies at our feet.

And if any of the ecclesiastical persons to whom I have referred, object that they find it derogatory to the honour of the God whom they worship, to awaken the minds of the young to the infinite wonder and majesty of the works which they proclaim His, and to teach them those laws which must needs be His laws, and therefore of all things needful for man to know–I can only recommend them to be let blood and put on low diet. There must be something very wrong going on in the instrument of logic if it turns out such conclusions from such premises.

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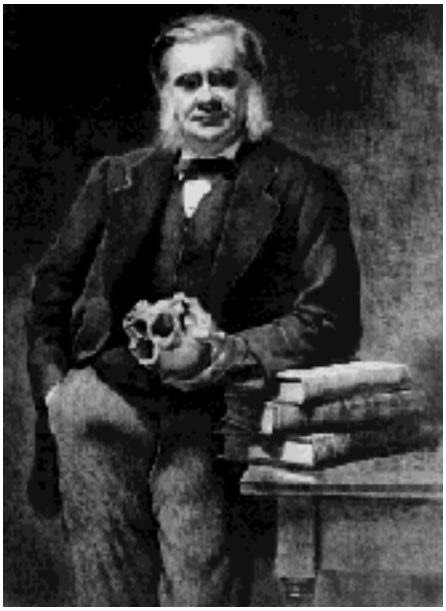
[1] "Mr. Quain's words (*Medical Times and Gazette*, February 20) are–"A few words as to our special Medical course of instruction and the influence upon it of such changes in the elementary schools as I have mentioned. The student now enters at once upon several sciences–physics, chemistry, anatomy, physiology, botany, pharmacy, therapeutics–all these, the facts and the language and the laws of each, to be mastered in eighteen months. Up to the beginning of the Medical course many have learned little. We cannot claim anything better than the Examiner of the University of London and the Cambridge Lecturer have reported for their Universities. Supposing that at school young people had acquired some exact elementary knowledge in physics, chemistry, and a branch of natural history–say botany–with the physiology connected with it they would then have gained necessary knowledge, with some practice in inductive reasoning. The whole studies are processes of observation and induction–the best discipline of the mind for the purposes of life–for our purposes not less than any. 'By such study (says Dr. Whewell) of one or more departments of inductive science the mind may escape from the thraldom of mere words.' By that plan the burden of the early Medical course would be much lightened, and more time devoted to practical studies, including Sir Thomas Watson's 'final and supreme stage' of the knowledge of Medicine."

THE HUXLEY FILE



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C. Blinderman & D. Joyce
Clark University

Lynton Huxleys

Taken by Mrs. Bailey at Lynton 1880

J. Huxley, *Diary of H.M.S. Rattlesnake*

Science and Culture (1880)

Collected Essays III

[134] Six years ago, as some of my present hearers may remember, I had the privilege of addressing a

large assemblage of the inhabitants of this city, who had gathered together to do honour to the memory of their famous townsman, Joseph Priestley;[1] and, if any satisfaction attaches to posthumous glory, we may hope that the manes of the burnt-out philosopher were then finally appeased.

No man, however, who is endowed with a fair share of common sense, and not more than a fair share of vanity, will identify either contemporary or posthumous fame with the highest good; and Priestley's life leaves no doubt that he, at any rate, set a much higher value upon the advancement of knowledge, and the promotion of that [135] freedom of thought which is at once the cause and the consequence of intellectual progress.

Hence I am disposed to think that, if Priestley could be amongst us to-day, the occasion of our meeting would afford him even greater pleasure than the proceedings which celebrated the centenary of his chief discovery. The kindly heart would be moved, the high sense of social duty would be satisfied, by the spectacle of well-earned wealth, neither squandered in tawdry luxury and vainglorious show, nor scattered with the careless charity which blesses neither him that gives nor him that takes, but expended in the execution of a well-considered plan for the aid of present and future generations of those who are willing to help themselves.

We shall all be of one mind thus far. But it is needful to share Priestley's keen interest in physical science; and to have learned, as he had learned, the value of scientific training in fields of inquiry apparently far remote from physical science; in order to appreciate, as he would have appreciated, the value of the noble gift which Sir Josiah Mason has bestowed upon the inhabitants of the Midland district.

For us children of the nineteenth century, however, the establishment of a college under the conditions of Sir Josiah Mason's Trust, has a significance apart from any which it could have possessed a hundred years ago. It appears to be [136] an indication that we are reaching the crisis of the battle, or rather of the long series of battles, which have been fought over education in a campaign which began long before Priestley's time, and will probably not be finished just yet.

In the last century, the combatants were the champions of ancient literature on the one side, and those of modern literature on the other; but, some thirty years[2] ago, the contest became complicated by the appearance of a third army, ranged round the banner of Physical Science.

I am not aware that any one has authority to speak in the name of this new host. For it must be admitted to be somewhat of a guerilla force, composed largely of irregulars, each of whom fights pretty much for his own hand. But the impressions of a full private, who has seen a good deal of service in the ranks, respecting the present position of affairs and the conditions of a permanent peace, may not be devoid of interest; and I do not know that I could make a better use of the present opportunity than by laying them before you.

From the time that the first suggestion to introduce physical science into ordinary education was [137] timidly whispered, until now, the advocates of scientific education have met with opposition of two

kinds. On the one hand, they have been pooh-poohed by the men of business who pride themselves on being the representatives of practicality; while, on the other hand, they have been excommunicated by the classical scholars, in their capacity of Levites in charge of the ark of culture and monopolists of liberal education.

The practical men believed that the idol whom they worship–rule of thumb–has been the source of the past prosperity, and will suffice for the future welfare of the arts and manufactures. They were of opinion that science is speculative rubbish; that theory and practice have nothing to do with one another; and that the scientific habit of mind is an impediment, rather than an aid, in the conduct of ordinary affairs.

I have used the past tense in speaking of the practical men–for although they were very formidable thirty years ago, I am not sure that the pure species has not been extirpated. In fact, so far as mere argument goes, they have been subjected to such a *feu d'enfer* that it is a miracle if any have escaped. But I have remarked that your typical practical man has an unexpected resemblance to one of Milton's angels. His spiritual wounds, such as are inflicted by logical weapons, may be as deep as a well and as wide as a church door, but beyond shedding a few drops [138] of ichor, celestial or otherwise, he is no whit the worse. So, if any of these opponents be left, I will not waste time in vain repetition of the demonstrative evidence of the practical value of science; but knowing that a parable will sometimes penetrate where syllogisms fail to effect an entrance, I will offer a story for their consideration.

Once upon a time, a boy, with nothing to depend upon but his own vigorous nature, was thrown into the thick of the struggle for existence in the midst of a great manufacturing population. He seems to have had a hard fight, inasmuch as, by the time he was thirty years of age, his total disposable funds amounted to twenty pounds. Nevertheless, middle life found him giving proof of his comprehension of the practical problems he had been roughly called upon to solve, by a career of remarkable prosperity.

Finally, having reached old age with its well-earned surroundings of "honour, troops of friends," the hero of my story bethought himself of those who were making a like start in life, and how he could stretch out a helping hand to them.

After long and anxious reflection this successful practical man of business could devise nothing better than to provide them with the means of obtaining "sound, extensive, and practical scientific knowledge." And he devoted a large part of his wealth and five years of incessant work to this end.

[139] I need not point the moral of a tale which, as the solid and spacious fabric of the Scientific College assures us, is no fable, nor can anything which I could say intensify the force of this practical answer to practical objections.

We may take it for granted then, that, in the opinion of those best qualified to judge, the diffusion of thorough scientific education is an absolutely essential condition of industrial progress; and that the College which has been opened to-day will confer an inestimable boon upon those whose livelihood is

to be gained by the practise of the arts and manufactures of the district.

The only question worth discussion is, whether the conditions, under which the work of the College is to be carried out, are such as to give it the best possible chance of achieving permanent success.

Sir Josiah Mason, without doubt most wisely, has left very large freedom of action to the trustees, to whom he proposes ultimately to commit the administration of the College, so that they may be able to adjust its arrangements in accordance with the changing conditions of the future. But, with respect to three points, he has laid most explicit injunctions upon both administrators and teachers.

Party politics are forbidden to enter into the [140] minds of either, so far as the work of the College is concerned; theology is as sternly banished from its precincts; and finally, it is especially declared that the College shall make no provision for "mere literary instruction and education."

It does not concern me at present to dwell upon the first two injunctions any longer than may be needful to express my full conviction of their wisdom. But the third prohibition brings us face to face with those other opponents of scientific education, who are by no means in the moribund condition of the practical man, but alive, alert, and formidable.

It is not impossible that we shall hear this express exclusion of "literary instruction and education" from a College which, nevertheless, professes to give a high and efficient education, sharply criticised. Certainly the time was that the Levites of culture would have sounded their trumpets against its walls as against an educational Jericho.

How often have we not been told that the study of physical science is incompetent to confer culture; that it touches none of the higher problems of life; and, what is worse, that the continual devotion to scientific studies tends to generate a narrow and bigoted belief in the applicability of scientific methods to the search after truth of all kinds? How frequently one has reason to observe that no reply to a troublesome [141] argument tells so well as calling its author a "mere scientific specialist." And, as I am afraid it is not permissible to speak of this form of opposition to scientific education in the past tense; may we not expect to be told that this, not only omission, but prohibition, of "mere literary instruction and education" is a patent example of scientific narrow-mindedness?

I am not acquainted with Sir Josiah Mason's reasons for the action which he has taken; but if, as I apprehend is the case, he refers to the ordinary classical course of our schools and universities by the name of "mere literary instruction and education," I venture to offer sundry reasons of my own in support of that action.

For I hold very strongly by two convictions–The first is, that neither the discipline nor the subject-matter of classical education is of such direct value to the student of physical science as to justify the expenditure of valuable time upon either; and the second is, that for the purpose of attaining real culture, an exclusively scientific education is at least as effectual as an exclusively literary education.

I need hardly point out to you that these opinions, especially the latter, are diametrically opposed to those of the great majority of educated Englishmen, influenced as they are by school and university traditions. In their belief, culture is [142] obtainable only by a liberal education; and a liberal education is synonymous, not merely with education and instruction in literature, but in one particular form of literature, namely, that of Greek and Roman antiquity. They hold that the man who has learned Latin and Greek, however little, is educated; while he who is versed in other branches of knowledge, however deeply, is a more or less respectable specialist, not admissible into the cultured caste. The stamp of the educated man, the University degree, is not for him.

I am too well acquainted with the generous catholicity of spirit, the true sympathy with scientific thought, which pervades the writings of our chief apostle of culture to identify him with these opinions; and yet one may cull from one and another of those epistles to the Philistines, which so much delight all who do not answer to that name, sentences which lend them some support.

Mr. Arnold tells us that the meaning of culture is "to know the best that has been thought and said in the world." It is the criticism of life contained in literature. That criticism regards "Europe as being, for intellectual and spiritual purposes, one great confederation, bound to a joint action and working to a common result; and whose members have, for their common outfit, a knowledge of Greek, Roman, and Eastern [143] antiquity, and of one another. Special, local, and temporary advantages being put out of account, that modern nation will in the intellectual and spiritual sphere make most progress, which most thoroughly carries out this programme. And what is that but saying that we too, all of us, as individuals, the more thoroughly we carry it out, shall make the more progress?"[3]

We have here to deal with two distinct propositions. The first, that a criticism of life is the essence of culture; the second, that literature contains the materials which suffice for the construction of such a criticism.

I think that we must all assent to the first proposition, For culture certainly means something quite different from learning or technical skill, It implies the possession of an ideal, and the habit of critically estimating the value of things by comparison with a theoretic standard. Perfect culture should supply a complete theory of life, based upon a clear knowledge alike of its possibilities and of its limitations.

But we may agree to all this, and yet strongly dissent from the assumption that literature alone is competent to supply this knowledge. After having learnt all that Greek, Roman, and Eastern antiquity have thought and said, and all that modern literatures have to tell us, it is not self-evident that we have laid a sufficiently broad [144] and deep foundation for that criticism of life, which constitutes culture.

Indeed, to any one acquainted with the scope of physical science, it is not at all evident. Considering progress only in the "intellectual and spiritual sphere," I find myself wholly unable to admit that either nations or individuals will really advance, if their common outfit draws nothing from the stores of physical science. I should say that an army, without weapons of precision and with no particular base of

operations, might more hopefully enter upon a campaign on the Rhine, than a man, devoid of a knowledge of what physical science has done in the last century, upon a criticism of life.

When a biologist meets with an anomaly, he instinctively turns to the study of development to clear it up. The rationale of contradictory opinions may with equal confidence be sought in history.

It is, happily, no new thing that Englishmen should employ their wealth in building and endowing institutions for educational purposes. But, five or six hundred years ago, deeds of foundation expressed or implied conditions as nearly as possible contrary to those which have been thought expedient by Sir Josiah Mason. That is to say, physical science was practically ignored, while a certain literary training was enjoined as a means to the acquirement of knowledge which was essentially theological.

[145] The reason of this singular contradiction between the actions of men alike animated by a strong and disinterested desire to promote the welfare of their fellows, is easily discovered.

At that time, in fact, if any one desired knowledge beyond such as could be obtained by his own observation, or by common conversation, his first necessity was to learn the Latin language, inasmuch as all the higher knowledge of the western world was contained in works written in that language. Hence, Latin grammar, with logic and rhetoric, studied through Latin, were the fundamentals of education. With respect to the substance of the knowledge imparted through this channel, the Jewish and Christian Scriptures, as interpreted and supplemented by the Romish Church, were held to contain a complete and infallibly true body of information.

Theological dicta were, to the thinkers of those days, that which the axioms and definitions of Euclid are to the geometers of these. The business of the philosophers of the middle ages was to deduce from the data furnished by the theologians, conclusions in accordance with ecclesiastical decrees. They were allowed the high privilege of showing, by logical process, how and why that which the church said was true, must be true. And if their demonstrations fell short of or exceeded this limit, the church was maternally ready to check their [146] aberrations; if need were by the help of the secular arm.

Between the two, our ancestors were furnished with a compact and complete criticism of life. They were told how the world began and how it would end; they learned that all material existence was but a base and insignificant blot upon the fair face of the spiritual world, and that nature was, to all intents and purposes, the play-ground of the devil; they learned that the earth is the centre of the visible universe, and that man is the cynosure of things terrestrial; and more especially was it inculcated that the course of nature had no fixed order, but that it could be, and constantly was, altered by the agency of innumerable spiritual beings, good and bad, according as they were moved by the deeds and prayers of men. The sum and substance of the whole doctrine was to produce the conviction that the only thing really worth knowing in this world was how to secure that place in a better which, under certain conditions, the church promised.

Our ancestors had a living belief in this theory of life, and acted upon it in their dealings with education,

as in all other matters. Culture meant saintliness–after the fashion of the saints of those days; the education that led to it was, of necessity, theological; and the way to theology lay through Latin.

That the study of nature–further than was re[147]quisite for the satisfaction of everyday wants–should have any bearing on human life was far from the thoughts of men thus trained. Indeed, as nature had been cursed for man's sake, it was an obvious conclusion that those who meddled with nature were likely to come into pretty close contact with Satan. And, if any born scientific investigator followed his instincts, he might safely reckon upon earning the reputation, and probably upon suffering the fate, of a sorcerer.

Had the western world been left to itself in Chinese isolation, there is no saying how long this state of things might have endured. But, happily, it was not left to itself. Even earlier than the thirteenth century, the development of Moorish civilisation in Spain and the great movement of the Crusades had introduced the leaven which, from that day to this, has never ceased to work. At first, through the intermediation of Arabic translations, afterwards by the study of the originals, the western nations of Europe became acquainted with the writings of the ancient philosophers and poets, and, in time, with the whole of the vast literature of antiquity.

Whatever there was of high intellectual aspiration or dominant capacity in Italy, France, Germany, and England, spent itself for centuries in taking possession of the rich inheritance left by the dead civilisations of Greece and Rome. Marvellously aided by the invention of printing, [148] classical learning spread and flourished. Those who possessed it prided themselves on having attained the highest culture then within the reach of mankind.

And justly. For, saving Dante on his solitary pinnacle, there was no figure in modern literature at the time of the Renascence to compare with the men of antiquity; there was no art to compete with their sculpture; there was no physical science but that which Greece had created. Above all, there was no other example of perfect intellectual freedom–of the unhesitating acceptance of reason as the sole guide to truth and the supreme arbiter of conduct.

The new learning necessarily soon exerted a profound influence upon education. The language of the monks and schoolmen seemed little better than gibberish to scholars fresh from Virgil and Cicero, and the study of Latin was placed upon a new foundation. Moreover, Latin itself ceased to afford the sole key to knowledge. The student who sought the highest thought of antiquity, found only a second-hand reflection of it in Roman literature, and turned his face to the full light of the Greeks. And after a battle, not altogether dissimilar to that which is at present being fought over the teaching of physical science, the study of Greek was recognised as an essential element of all higher education.

Thus the Humanists, as they were called, won [149] the day; and the great reform which they effected was of incalculable service to mankind. But the Nemesis of all reformers is finality; and the reformers of education, like those of religion, fell into the profound, however common, error of mistaking the beginning for the end of the work of reformation.

The representatives of the Humanists, in the nineteenth century, take their stand upon classical education as the sole avenue to culture, as firmly as if we were still in the age of Renascence. Yet, surely, the present intellectual relations of the modern and the ancient worlds are profoundly different from those which obtained three centuries ago. Leaving aside the existence of a great and characteristically modern literature, of modern painting, and, especially, of modern music, there is one feature of the present state of the civilised world which separates it more widely from the Renascence, than the Renascence was separated from the middle ages.

This distinctive character of our own times lies in the vast and constantly increasing part which is played by natural knowledge. Not only is our daily life shaped by it, not only does the prosperity of millions of men depend upon it, but our whole theory of life has long been influenced, consciously or unconsciously, by the general conceptions of the universe, which have been forced upon us by physical science.

[150] In fact, the most elementary acquaintance with the results of scientific investigation shows us that they offer a broad and striking contradiction to the opinion so implicitly credited and taught in the middle ages.

The notions of the beginning and the end of the world entertained by our forefathers are no longer credible. It is very certain that the earth is not the chief body in the material universe, and that the world is not subordinated to man's use. It is even more certain that nature is the expression of a definite order with which nothing interferes, and that the chief business of mankind is to learn that order and govern themselves accordingly. Moreover this scientific "criticism of life" presents itself to us with different credentials from any other. It appeals not to authority, nor to what anybody may have thought or said, but to nature. It admits that all our interpretations of natural fact are more or less imperfect and symbolic, and bids the learner seek for truth not among words but among things. It warns us that the assertion which outstrips evidence is not only a blunder but a crime.

The purely classical education advocated by the representatives of the Humanists in our day, gives no inkling of all this. A man may be a better scholar than Erasmus, and know no more of the chief causes of the present intellectual fermentation than Erasmus did. Scholarly and [151] pious persons, worthy of all respect, favour us with allocutions upon the sadness of the antagonism of science to their mediæval way of thinking, which betray an ignorance of the first principles of scientific investigation, an incapacity for understanding what a man of science means by veracity, and an unconsciousness of the weight of established scientific truths, which is almost comical.

There is no great force in the *tu quoque* argument, or else the advocates of scientific education might fairly enough retort upon the modern Humanists that they may be learned specialists, but that they possess no such sound foundation for a criticism of life as deserves the name of culture. And, indeed, if we were disposed to be cruel, we might urge that the Humanists have brought this reproach upon themselves, not because they are too full of the spirit of the ancient Greek, but because they lack it.

The period of the Renascence is commonly called that of the "Revival of Letters," as if the influences then brought to bear upon the mind of Western Europe had been wholly exhausted in the field of literature. I think it is very commonly forgotten that the revival of science, effected by the same agency, although less conspicuous, was not less momentous.

In fact, the few and scattered students of nature of that day picked up the clue to her secrets exactly as it fell from the hands of the [152] Greeks a thousand years before. The foundations of mathematics were so well laid by them, that our children learn their geometry from a book written for the schools of Alexandria two thousand years ago. Modern astronomy is the natural continuation and development of the work of Hipparchus and of Ptolemy; modem physics of that of Democritus and of Archimedes; it was long before modern biological science outgrew the knowledge bequeathed to us by Aristotle, by Theophrastus, and by Galen.

We cannot know all the best thoughts and sayings of the Greeks unless we know what they thought about natural phænomena. We cannot fully apprehend their criticism of life unless we understand the extent to which that criticism was affected by scientific conceptions. We falsely pretend to be the inheritors of their culture, unless we are penetrated, as the best minds among them were, with an unhesitating faith that the free employment of reason, in accordance with scientific method, is the sole method of reaching truth.

Thus I venture to think that the pretensions of our modern Humanists to the possession of the monopoly of culture and to the exclusive inheritance of the spirit of antiquity must be abated, if not abandoned. But I should be very sorry that anything I have said should be taken to imply a desire on my part to depreciate the value of classical education, as it might be and as it some[153]times is. The native capacities of mankind vary no less than their opportunities; and while culture is one, the road by which one man may best reach it is widely different from that which is most advantageous to another. Again, while scientific education is yet inchoate and tentative, classical education is thoroughly well organised upon the practical experience of generations of teachers. So that, given ample time for learning and destination for ordinary life, or for a literary career, I do not think that a young Englishman in search of culture can do better than follow the course usually marked out for him, supplementing its deficiencies by his own efforts.

But for those who mean to make science their serious occupation; or who intend to follow the profession of medicine; or who have to enter early upon the business of life; for all these, in my opinion, classical education is a mistake; and it is for this reason that I am glad to see "mere literary education and instruction" shut out from the curriculum of Sir Josiah Mason's College, seeing that its inclusion would probably lead to the introduction of the ordinary smattering of Latin and Greek.

Nevertheless, I am the last person to question the importance of genuine literary education, or to suppose that intellectual culture can be complete without it. An exclusively scientific training will bring about a mental twist as surely as an [154] exclusively literary training. The value of the cargo does not compensate for a ship's being out of trim; and I should be very sorry to think that the Scientific College

would turn out none but lop-sided men.

There is no need, however, that such a catastrophe should happen. Instruction in English, French, and German is provided, and thus the three greatest literatures of the modern world are made accessible to the student.

French and German, and especially the latter language, are absolutely indispensable to those who desire full knowledge in any department of science. But even supposing that the knowledge of these languages acquired is not more than sufficient for purely scientific purposes, every Englishman has, in his native tongue, an almost perfect instrument of literary expression; and, in his own literature, models of every kind of literary excellence. If an Englishman cannot get literary culture out of his Bible, his Shakespeare, his Milton, neither, in my belief, will the profoundest study of Homer and Sophocles, Virgil and Horace, give it to him.

Thus, since the constitution of the College makes sufficient provision for literary as well as for scientific education, and since artistic instruction is also contemplated, it seems to me that a fairly complete culture is offered to all who are willing to take advantage of it.

[155] But I am not sure that at this point the "practical" man, scotched but not slain, may ask what all this talk about culture has to do with an Institution, the object of which is defined to be "to promote the prosperity of the manufactures and the industry of the country." He may suggest that what is wanted for this end is not culture, nor even a purely scientific discipline, but simply a knowledge of applied science.

I often wish that this phrase, "applied science," had never been invented. For it suggests that there is a sort of scientific knowledge of direct practical use, which can be studied apart from another sort of scientific knowledge, which is of no practical utility, and which is termed "pure science." But there is no more complete fallacy than this. What people call applied science is nothing but the application of pure science to particular classes of problems. It consists of deductions from those general principles, established by reasoning and observation, which constitute pure science. No one can safely make these deductions until he has a firm grasp of the principles; and he can obtain that grasp only by personal experience of the operations of observation and of reasoning on which they are founded.

Almost all the processes employed in the arts and manufactures fall within the range either of physics or of chemistry. In order to improve them, one must thoroughly understand them; and [156] no one has a chance of really understanding them unless he has obtained that mastery of principles and that habit of dealing with facts, which is given by long-continued and well-directed purely scientific training in the physical and the chemical laboratory. So that there really is no question as to the necessity of purely scientific discipline, even if the work of the College were limited by the narrowest interpretation of its stated aims.

And, as to the desirableness of a wider culture than that yielded by science alone, it is to be recollected that the improvement of manufacturing processes is only one of the conditions which contribute to the

prosperity of industry. Industry is a means and not an end; and mankind work only to get something which they want. What that something is depends partly on their innate, and partly on their acquired, desires.

If the wealth resulting from prosperous industry is to be spent upon the gratification of unworthy desires, if the increasing perfection of manufacturing processes is to be accompanied by an increasing debasement of those who carry them on, I do not see the good of industry and prosperity.

Now it is perfectly true that men's views of what is desirable depend upon their characters; and that the innate proclivities to which we give that name are not touched by any amount of instruction. But it does not follow that even mere intellectual education may not, to an indefinite [157] extent, modify the practical manifestation of the characters of men in their actions, by supplying them with motives unknown to the ignorant. A pleasure-loving character will have pleasure of some sort; but, if you give him the choice, he may prefer pleasures which do not degrade him to those which do. And this choice is offered to every man, who possesses in literary or artistic culture a never-failing source of pleasures, which are neither withered by age, nor staled by custom, nor embittered in the recollection by the pangs of self-reproach.

If the Institution opened to-day fulfils the intention of its founder, the picked intelligences among all classes of the population of this district will pass through it. No child born in Birmingham, henceforward, if he have the capacity to profit by the opportunities offered to him, first in the primary and other schools, and afterwards in the Scientific College, need fail to obtain, not merely the instruction, but the culture most appropriate to the conditions of his life.

Within these walls, the future employer and the future artisan may sojourn together for a while, and carry, through all their lives, the stamp of the influences then brought to bear upon them. Hence, it is not beside the mark to remind you, that the prosperity of industry depends not merely upon the improvement of manufacturing processes, not merely upon the ennabling of the individual char[158]acter, but upon a third condition, namely, a clear understanding of the conditions of social life, on the part of both the capitalist and the operative, and their agreement upon common principles of social action. They must learn that social phænomena are as much the expression of natural laws as any others; that no social arrangements can be permanent unless they harmonise with the requirements of social statics and dynamics; and that, in the nature of things, there is an arbiter whose decisions execute themselves.

But this knowledge is only to be obtained by the application of the methods of investigation adopted in physical researches to the investigation of the phænomena of society. Hence, I confess, I should like to see one addition made to the excellent scheme of education propounded for the College, in the shape of provision for the teaching of Sociology. For though we are all agreed that party politics are to have no place in the instruction of the College; yet in this country, practically governed as it is now by universal suffrage, every man who does his duty must exercise political functions. And, if the evils which are inseparable from the good of political liberty are to be checked, if the perpetual oscillation of nations between anarchy and despotism is to be replaced by the steady march of self-restraining freedom; it will

be because men will gradually bring themselves to deal with political, as they now deal with scientific [159] questions; to be as ashamed of undue haste and partisan prejudice in the one case as in the other; and to believe that the machinery of society is at least as delicate as that of a spinning-jenny, and as little likely to be improved by the meddling of those who have not taken the trouble to master the principles of its action.

In conclusion, I am sure that I make myself the mouthpiece of all present in offering to the venerable founder of the Institution, which now commences its beneficent career, our congratulations on the completion of his work; and in expressing the conviction, that the remotest posterity will point to it as a crucial instance of the wisdom which natural piety leads all men to ascribe to their ancestors.

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[1] See the first essay in this volume.

[2] The advocacy of the introduction of physical science into general education by George Combe and others commenced a good deal earlier; but the movement had acquired hardly any practical force before the time to which I refer.

[3] *Essays in Criticism*, p.37.

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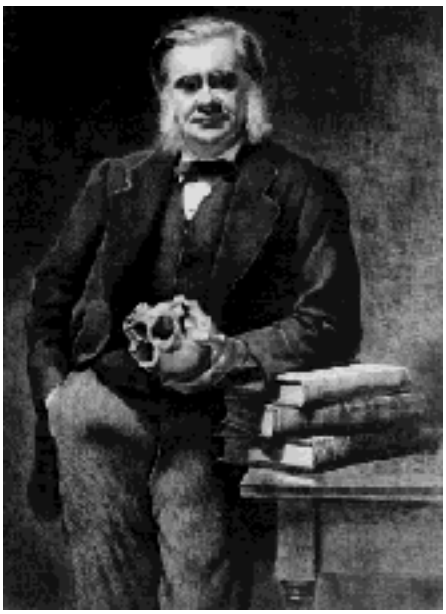


On Science and Art in Relation to Education (1882)

Collected Essays III

[160] When a man is honoured by such a request as that which reached me from the authorities of your institution some time ago, I think the first thing that occurs to him is that which occurred to those who were bidden to the feast in the Gospel–to begin to make an excuse; and probably all the excuses suggested on that famous occasion crop up in his mind one after the other, including his "having married a wife," as reasons for not doing what he is asked to do. But, in my own case, and on this particular occasion, there were other difficulties of a sort peculiar to the time, and more or less personal to myself; because I felt that, if I came amongst you, I should be expected, and, indeed, morally compelled, to speak upon the subject of Scientific Education. And then there [161] arose in my mind the recollection of a fact, which probably no one here but myself remembers; namely, that some fourteen years ago I was the guest of a citizen of yours, who bears the honoured name of Rathbone, at a very charming and pleasant dinner given by the Philomathic Society; and I there and then, and in this very city, made a speech upon the topic of Scientific Education. Under these circumstances, you see, one runs two dangers–the first, of repeating one's self, although I may fairly hope that everybody has forgotten the fact I have just now mentioned, except myself; and the second, and even greater difficulty, is the danger of saying something different from what one said before, because then, however forgotten your previous speech may be, somebody finds out its existence, and there goes on that process so hateful to members of Parliament, which may be denoted by the term "Hansardisation." Under these circumstances, I came to the conclusion that the best thing I could do was to take the bull by the horns, and to "Hansardise" myself,–to put before you, in the briefest possible way, the three or four propositions which I endeavoured to support on the occasion of the speech to which I have referred; and then to ask myself, supposing you were asking me, whether I had anything to retract, or to modify, in them, in virtue of the increased experience, and, let us charitably hope, the increased wisdom of an added fourteen years.

[162] Now, the points to which I directed particular attention on that occasion were these: in the first place, that instruction in physical science supplies information of a character of especial value, both in a practical and a speculative point of view–information which cannot be obtained otherwise; and, in the second place, that, as educational discipline, it supplies, in a better form than any other study can supply, exercise in a special form of logic, and a peculiar method of testing the validity of our processes of inquiry. I said further, that, even at that time, a great and increasing attention was being paid to physical science in our schools and colleges, and that, most assuredly, such attention must go on growing and increasing, until education in these matters occupied a very much larger share of the time which is given to teaching and training, than had been the case heretofore. And I threw all the strength of argumentation of which I was possessed into the support of these propositions. But I venture to remind you, also, of some other words I used at that time, and which I ask permission to read to you. They were these:–"There are other forms of culture besides physical science, and I should be profoundly sorry to see the fact forgotten, or even to observe a tendency to starve or cripple literary or æsthetic culture for the sake of science. Such a narrow view of the nature of education has nothing to do with my firm

conclusion that a complete and thorough [163] scientific culture ought to be introduced into all schools."

I say I desire, in commenting upon these various points, and judging them as fairly as I can by the light of increased experience, to particularly emphasise this last, because I am told, although I assuredly do not know it of my own knowledge–though I think if the fact were so I ought to know it, being tolerably well acquainted with that which goes on in the scientific world, and which has gone on there for the last thirty years–that there is a kind of sect, or horde, of scientific Goths and Vandals, who think it would be proper and desirable to sweep away all other forms of culture and instruction, except those in physical science, and to make them the universal and exclusive, or, at any rate, the dominant training of the human mind of the future generation. This is not my view–I do not believe that it is anybody's view–but it is attributed to those who, like myself advocate scientific education. I therefore dwell strongly upon the point, and I beg you to believe that the words I have just now read were by no means intended by me as a sop to the Cerberus of culture. I have not been in the habit of offering sops to any kind of Cerberus; but it was an expression of profound conviction on my own part–a conviction forced upon me not only by my mental constitution, but by the lessons of what is [164] now becoming a somewhat long experience of varied conditions of life.

I am not about to trouble you with my autobiography; the omens are hardly favourable, at present, for work of that kind. But I should like if I may do so without appearing, what I earnestly desire not to be, egotistical,–I should like to make it clear to you, that such notions as these, which are sometimes attributed to me, are, as I have said, inconsistent with my mental constitution, and still more inconsistent with the upshot of the teaching of my experience. For I can certainly claim for myself that sort of mental temperament which can say that nothing human comes amiss to it. I have never yet met with any branch of human knowledge which I have found unattractive–which it would not have been pleasant to me to follow, so far as I could go; and I have yet to meet with any form of art in which it has not been possible for me to take as acute a pleasure as, I believe, it is possible for men to take.

And with respect to the circumstances of life, it so happens that it has been my fate to know many lands and many climates, and to be familiar, by personal experience, with almost every form of society, from the uncivilised savage of Papua and Australia and the civilised savages of the slums and dens of the poverty-stricken parts of great cities, to those who perhaps, are occasionally [165] the somewhat over-civilised members of our upper ten thousand. And I have never found, in any of these conditions of life, a deficiency of something which was attractive. Savagery has its pleasures, I assure you, as well as civilisation, and I may even venture to confess–if you will not let a whisper of the matter get back to London, where I am known–I am even fain to confess, that sometimes in the din and throng of what is called "a brilliant reception" the vision crosses my mind of waking up from the soft plank which had afforded me satisfactory sleep during the hours of the night, in the bright dawn of a tropical morning, when my comrades were yet asleep, when every sound was hushed, except the little lap-lap of the ripples against the sides of the boat, and the distant twitter of the sea-bird on the reef. And when that vision crosses my mind, I am free to confess I desire to be back in the boat again. So that, if I share with those strange persons to whose asserted, but still hypothetical existence I have referred, the want of appreciation of forms of culture other than the pursuit of physical science, all I can say is, that it is, in spite of my constitution, and in spite of my experience, that such should be my fate.

But now let me turn to another point, or rather to two other points, with which I propose to occupy myself. How far does the experience of the last fourteen years justify the estimate which [166] I ventured to put forward of the value of scientific culture, and of the share–the increasing share–which it must take in ordinary education? Happily, in respect to that matter, you need not rely upon my testimony. In the last half-dozen numbers of the "Journal of Education," you will find a series of very interesting and remarkable papers, by gentlemen who are practically engaged in the business of education in our great public and other schools, telling us what is doing in these schools, and what is their experience of the results of scientific education there, so far as it has gone. I am not going to trouble you with an abstract of those papers, which are well worth your study in their fulness and completeness, but I have copied out one remarkable passage, because it seems to me so entirely to bear out what I have formerly ventured to say about the value of science, both as to its subject-matter and as to the discipline which the learning of science involves. It is from a paper by Mr. Worthington–one of the masters at Clifton, the reputation of which school you know well, and at the head of which is an old friend of mine, the Rev. Mr. Wilson–to whom much credit is due for being one of the first, as I can say from my own knowledge, to take up this question and work it into practical shape. What Mr. Worthington says is this:–

"It is not easy to exaggerate the importance of the information imparted by certain branches of science; it modifies the [167] whole criticism of life made in maturer years. The study has often, on a mass of boys, a certain influence which, I think, was hardly anticipated, and to which a good deal of value must be attached–an influence as much moral as intellectual, which is shown in the increased and increasing respect for precision of statement, and for that form of veracity which consists in the acknowledgment of difficulties. It produces a real effect to find that nature cannot be imposed upon, and the attention given to experimental lectures, at first superficial and curious only, soon becomes minute, serious, and practical."

Ladies and gentlemen, I could not have chosen better words to express–in fact, I have, in other words, expressed the same conviction in former days–what the influence of scientific teaching, if properly carried out, must be.

But now comes the question of properly carrying it out, because, when I hear the value of school teaching in physical science disputed, my first impulse is to ask the disputer, "What have you known about it?" and he generally tells me some lamentable case of failure. Then I ask, "What are the circumstances of the case, and how was the teaching carried out?" I remember, some few years ago, hearing of the head master of a large school, who had expressed great dissatisfaction with the adoption of the teaching of physical science–and that after experiment. But the experiment consisted in this–in asking one of the junior masters in the school to get up science, in order to teach it; and the young gentleman went away for a year and got up science and taught it. Well, I have [168] no doubt that the result was as disappointing as the head-master said it was, and I have no doubt that it ought to have been as disappointing, and far more disappointing too; for, if this kind of instruction is to be of any good at all, if it is not to be less than no good, if it is to take the place of that which is already of some good, then there are several points which must be attended to.

And the first of these is the proper selection of topics, the second is practical teaching, the third is practical teachers, and the fourth is sufficiency of time. If these four points are not carefully attended to by anybody who undertakes the teaching of physical science in schools, my advice to him is, to let it alone. I will not dwell at any length upon the first point, because there is a general consensus of opinion as to the nature of the topics which should be chosen. The second point–practical teaching–is one of great importance, because it requires more capital to set it agoing, demands more time, and, last, but by no means least, it requires much more personal exertion and trouble on the part of those professing to teach, than is the case with other kinds of instruction.

When I accepted the invitation to be here this evening, your secretary was good enough to send me the addresses which have been given by distinguished persons who have previously occupied this chair. I don't know whether he had a malicious desire to alarm me; but, however that [169] may be, I read the addresses, and derived the greatest pleasure and profit from some of them, and from none more than from the one given by the great historian, Mr. Freeman, which delighted me most of all; and, if I had not been ashamed of plagiarising, and if I had not been sure of being found out, I should have been glad to have copied very much of what Mr. Freeman said, simply putting in the word science for history. There was one notable passage,–"The difference between good and bad teaching mainly consists in this, whether the words used are really clothed with a meaning or not." And Mr. Freeman gives a remarkable example of this. He says, when a little girl was asked where Turkey was, she answered that it was in the yard with the other fowls, and that showed she had a definite idea connected with the word Turkey, and was, so far, worthy of praise. I quite agree with that commendation; but what a curious thing it is that one should now find it necessary to urge that this is the be-all and end-all of scientific instruction–the *sine qua non,* the absolutely necessary condition,–and yet that it was insisted upon more than two hundred years ago by one of the greatest men science ever possessed in this country, William Harvey. Harvey wrote or at least published, only two small books, one of which is the well-known treatise on the circulation of the blood. The other, the "Exercitationes de Generatione," is [170] less known, but not less remarkable. And not the least valuable part of it is the preface, in which there occurs this passage: "Those who, reading the words of authors, do not form sensible images of the things referred to, obtain no true ideas, but conceive false imaginations and inane phantasms." You see, William Harvey's words are just the same in substance as those of Mr. Freeman, only they happen to be rather more than two centuries older. So that what I am now saying has its application elsewhere than in science; but assuredly in science the condition of knowing, of your own knowledge, things which you talk about, is absolutely imperative.

I remember, in my youth, there were detestable books which ought to have been burned by the hands of the common hangman, for they contained questions and answers to be learned by heart, of this sort, "What is a horse? The horse is termed *Equus caballus;* belongs to the class Mammalia; order, Pachydermata; family, Solidungula." Was any human being wiser for learning that magic formula? Was he not more foolish, inasmuch as he was deluded into taking words for knowledge? It is that kind of teaching that one wants to get rid of, and banished out of science. Make it as little as you like, but, unless that which is taught is based on actual observation and familiarity with facts, it is better left alone.

There are a great many people who imagine that [171] elementary teaching might be properly carried

out by teachers provided with only elementary knowledge. Let me assure you that that is the profoundest mistake in the world. There is nothing so difficult to do as to write a good elementary book, and there is nobody so hard to teach properly and well as people who know nothing about a subject, and I will tell you why. If I address an audience of persons who are occupied in the same line of work as myself, I can assume that they know a vast deal, and that they can find out the blunders I make. If they don't, it is their fault and not mine; but when I appear before a body of people who know nothing about the matter, who take for gospel whatever I say, surely it becomes needful that I consider what I say, make sure that it will bear examination, and that I do not impose upon the credulity of those who have faith in me. In the second place, it involves that difficult process of knowing what you know so well that you can talk about it as you can talk about your ordinary business. A man can always talk about his own business. He can always make it plain; but, if his knowledge is hearsay, he is afraid to go beyond what he has recollected, and put it before those that are ignorant in such a shape that they shall comprehend it. That is why, to be a good elementary teacher, to teach the elements of any subject, requires most careful consideration, if you are a master of the subject; and, if you are not a master [172] of it, it is needful you should familiarise yourself with so much as you are called upon to teach–soak yourself in it, so to speak–until you know it as part of your daily life and daily knowledge, and then you will be able to teach anybody. That is what I mean by practical teachers, and, although the deficiency of such teachers is being remedied to a large extent, I think it is one which has long existed, and which has existed from no fault of those who undertook to teach, but because, until the last score of years, it absolutely was not possible for any one in a great many branches of science, whatever his desire might be, to get instruction which would enable him to be a good teacher of elementary things. All that is being rapidly altered, and I hope it will soon become a thing of the past.

The last point I have referred to is the question of the sufficiency of time. And here comes the rub. The teaching of science needs time, as any other subject; but it needs more time proportionally than other subjects, for the amount of work obviously done, if the teaching is to be, as I have said, practical. Work done in a laboratory involves a good deal of expenditure of time without always an obvious result, because we do not see anything of that quiet process of soaking the facts into the mind, which takes place through the organs of the senses. On this ground there must be ample time given to science teaching. What that amount of time should be is a point which I need not [173] discuss now; in fact, it is a point which cannot be settled until one has made up one's mind about various other questions.

All, then, that I have to ask for, on behalf of the scientific people, if I may venture to speak for more than myself, is that you should put scientific teaching into what statesmen call the condition of "the most favoured nation"; that is to say, that it shall have as large a share of the time given to education as any other principal subject. You may say that that is a very vague statement, because the value of the allotment of time, under those circumstances, depends upon the number of principal subjects. It is *x* the time, and an unknown quantity of principal subjects dividing that, and science taking shares with the rest. That shows that we cannot deal with this question fully until we have made up our minds as to what the principal subjects of education ought to be.

I know quite well that launching myself into this discussion is a very dangerous operation; that it is a very large subject, and one which is difficult to deal with, however much I may trespass upon your

patience in the time allotted to me. But the discussion is so fundamental, it is so completely impossible to make up one's mind on these matters until one has settled the question, that I will even venture to make the experiment. A great lawyer-statesman and philosopher of a former [174] age–I mean Francis Bacon–said that truth came out of error much more rapidly than it came out of confusion. There is a wonderful truth in that saying. Next to being right in this world, the best of all things is to be clearly and definitely wrong, because you will come out somewhere. If you go buzzing about between right and wrong, vibrating and fluctuating, you come out nowhere; but if you are absolutely and thoroughly and persistently wrong, you must, some of these days, have the extreme good fortune of knocking your head against a fact, and that sets you all straight again. So I will not trouble myself as to whether I may be right or wrong in what I am about to say, but at any rate I hope to be clear and definite; and then you will be able to judge for yourselves whether, in following out the train of thought I have to introduce, you knock your heads against facts or not.

I take it that the whole object of education is, in the first place, to train the faculties of the young in such a manner as to give their possessors the best chance of being happy and useful in their generation; and, in the second place, to furnish them with the most important portions of that immense capitalised experience of the human race which we call knowledge of various kinds. I am using the term knowledge in its widest possible sense; and the question is, what subjects to select by training and discipline, in which the object I have just defined may be best attained.

[175] I must call your attention further to this fact, that all the subjects of our thoughts–all feelings and propositions (leaving aside our sensations as the mere materials and occasions of thinking and feeling), all our mental furniture–may be classified under one of two heads–as either within the province of the intellect, something that can be put into propositions and affirmed or denied; or as within the province of feeling, or that which, before the name was defiled, was called the æsthetic side of our nature, and which can neither be proved nor disproved, but only felt and known.

According to the classification which I have put before you, then, the subjects of all knowledge are divisible into the two groups, matters of science and matters of art; for all things with which the reasoning faculty alone is occupied, come under the province of science; and in the broadest sense, and not in the narrow and technical sense in which we are now accustomed to use the word art, all things feelable, all things which stir our emotions, come under the term of art, in the sense of the subject-matter of the æsthetic faculty. So that we are shut up to this–that the business of education is, in the first place, to provide the young with the means and the habit of observation; and, secondly, to supply the subject-matter of knowledge either in the shape of science or of art, or of both combined.

[176] Now, it is a very remarkable fact–but it is true of most things in this world–that there is hardly anything one-sided, or of one nature; and it is not immediately obvious what of the things that interest us may be regarded as pure science, and what may be regarded as pure art. It may be that there are some peculiarly constituted persons who, before they have advanced far into the depths of geometry, find artistic beauty about it; but, taking the generality of mankind, I think it may be said that, when they begin to learn mathematics, their whole souls are absorbed in tracing the connection between the premisses and the conclusion, and that to them geometry is pure science. So I think it may be said that

mechanics and osteology are pure science. On the other hand, melody in music is pure art. You cannot reason about it; there is no proposition involved in it. So, again, in the pictorial art, an arabesque, or a "harmony in grey," touches none but the æsthetic faculty. But a great mathematician, and even many persons who are not great mathematicians, will tell you that they derive immense pleasure from geometrical reasonings. Everybody knows mathematicians speak of solutions and problems as "elegant," and they tell you that a certain mass of mystic symbols is "beautiful, quite lovely." Well, you do not see it. They do see it, because the intellectual process, the process of comprehending the reasons symbolised by these [177] figures and these signs, confers upon them a sort of pleasure, such as an artist has in visual symmetry. Take a science of which I may speak with more confidence, and which is the most attractive of those I am concerned with. It is what we call morphology, which consists in tracing out the unity in variety of the infinitely diversified structures of animals and plants. I cannot give you any example of a thorough æsthetic pleasure more intensely real than a pleasure of this kind–the pleasure which arises in one's mind when a whole mass of different structures run into one harmony as the expression of a central law. That is where the province of art overlays and embraces the province of intellect. And, if I may venture to express an opinion on such a subject, the great majority of forms of art are not in the sense what I just now defined them to be–pure art; but they derive much of their quality from simultaneous and even unconscious excitement of the intellect.

When I was a boy, I was very fond of music, and I am so now; and it so happened that I had the opportunity of hearing much good music. Among other things, I had abundant opportunities of hearing that great old master, Sebastian Bach. I remember perfectly well–though I knew nothing about music then, and, I may add, know nothing whatever about it now–the intense satisfaction and delight which I had in listening, [178] by the hour together, to Bach's fugues. It is a pleasure which remains with me, I am glad to think; but, of late years, I have tried to find out the why and wherefore, and it has often occurred to me that the pleasure derived from musical compositions of this kind is essentially of the same nature as that which is derived from pursuits which are commonly regarded as purely intellectual. I mean, that the source of pleasure is exactly the same as in most of my problems in morphology–that you have the theme in one of the old master's works followed out in all its endless variations, always appearing and always reminding you of unity in variety. So in painting; what is called "truth to nature" is the intellectual element coming in, and truth to nature depends entirely upon the intellectual culture of the person to whom art is addressed. If you are in Australia, you may get credit for being a good artist–I mean among the natives–if you can draw a kangaroo after a fashion. But, among men of higher civilisation, the intellectual knowledge we possess brings its criticism into our appreciation of works of art, and we are obliged to satisfy it, as well as the mere sense of beauty in colour and in outline. And so, the higher the culture and information of those whom art addresses, the more exact and precise must be what we call its "truth to nature."

If we turn to literature, the same thing is true, [179] and you find works of literature which may be said to be pure art. A little song of Shakespeare or of Goethe is pure art; it is exquisitely beautiful, although its intellectual content may be nothing. A series of pictures is made to pass before your mind by the meaning of words, and the effect is a melody of ideas. Nevertheless, the great mass of the literature we esteem is valued, not merely because of having artistic form, but because of its intellectual content; and the value is the higher the more precise, distinct, and true is that intellectual content. And, if you will let

me for a moment speak of the very highest forms of literature, do we not regard them as highest simply because the more we know the truer they seem, and the more competent we are to appreciate beauty the more beautiful they are? No man ever understands Shakespeare until he is old, though the youngest may admire him, the reason being that he satisfies the artistic instinct of the youngest and harmonises with the ripest and richest experience of the oldest.

I have said this much to draw your attention to what, to my mind, lies at the root of all this matter, and at the understanding of one another by the men of science on the one hand, and the men of literature, and history, and art, on the other. It is not a question whether one order of study or another should predominate. It is a question of what topics of education you shall [180] select which will combine all the needful elements in such due proportion as to give the greatest amount of food, support, and encouragement to those faculties which enable us to appreciate truth, and to profit by those sources of innocent happiness which are open to us, and, at the same time, to avoid that which is bad, and coarse, and ugly, and keep clear of the multitude of pitfalls and dangers which beset those who break through the natural or moral laws.

I address myself, in this spirit, to the consideration of the question of the value of purely literary education. Is it good and sufficient, or is it insufficient and bad? Well, here I venture to say that there are literary educations and literary educations. If I am to understand by that term the education that was current in the great majority of middle-class schools, and upper schools too, in this country when I was a boy, and which consisted absolutely and almost entirely in keeping boys for eight or ten years at learning the rules of Latin and Greek grammar, construing certain Latin and Greek authors, and possibly making verses which, had they been English verses, would have been condemned as abominable doggerel,–if that is what you mean by liberal education, then I say it is scandalously insufficient and almost worthless. My reason for saying so is not from the point of view of science at all, but from the point of view of literature. I say the [181] thing professes to be literary education that is not a literary education at all. It was not literature at all that was taught, but science in a very bad form. It is quite obvious that grammar is science and not literature. The analysis of a text by the help of the rules of grammar is just as much a scientific operation as the analysis of a chemical compound by the help of the rules of chemical analysis. There is nothing that appeals to the æsthetic faculty in that operation; and I ask multitudes of men of my own age, who went through this process, whether they ever had a conception of art or literature until they obtained it for themselves after leaving school? Then you may say, "If that is so, if the education was scientific, why cannot you be satisfied with it?" I say, because although it is a scientific training, it is of the most inadequate and inappropriate kind. If there is any good at all in scientific education it is that men should be trained, as I said before, to know things for themselves at first hand, and that they should understand every step of the reason of that which they do.

I desire to speak with the utmost respect of that science–philology–of which grammar is a part and parcel; yet everybody knows that grammar, as it is usually learned at school, affords no scientific training. It is taught just as you would teach the rules of chess or draughts. On the other hand, if I am to understand by a literary education [182] the study of the literatures of either ancient or modern nations–but especially those of antiquity, and especially that of ancient Greece; if this literature is studied, not merely from the point of view of philological science, and its practical application to the

interpretation of texts, but as an exemplification of and commentary upon the principles of art; if you look upon the literature of a people as a chapter in the development of the human mind, if you work out this in a broad spirit, and with such collateral references to morals and politics, and physical geography, and the like as are needful to make you comprehend what the meaning of ancient literature and civilisation is,–then, assuredly, it affords a splendid and noble education. But I still think it is susceptible of improvement, and that no man will ever comprehend the real secret of the difference between the ancient world and our present time, unless he has learned to see the difference which the late development of physical science has made between the thought of this day and the thought of that, and he will never see that difference, unless he has some practical insight into some branches of physical science; and you must remember that a literary education such as that which I have just referred to, is out of the reach of those whose school life is cut short at sixteen or seventeen.

But, you will say, all this is fault-finding; let [183] us hear what you have in the way of positive suggestion. Then I am bound to tell you that, if I could make a clean sweep of everything–I am very glad I cannot because I might, and probably should, make mistakes,–but if I could make a clean sweep of everything and start afresh, I should, in the first place, secure that training of the young in reading and writing, and in the habit of attention and observation, both to that which is told them, and that which they see, which everybody agrees to. But in addition to that, I should make it absolutely necessary for everybody, for a longer or shorter period, to learn to draw. Now, you may say, there are some people who cannot draw, however much they may be taught. I deny that *in toto,* because I never yet met with anybody who could not learn to write. Writing is a form of drawing; therefore if you give the same attention and trouble to drawing as you do to writing, depend upon it, there is nobody who cannot be made to draw, more or less well. Do not misapprehend me. I do not say for one moment you would make an artistic draughtsman. Artists are not made; they grow. You may improve the natural faculty in that direction, but you cannot make it; but you can teach simple drawing, and you will find it an implement of learning of extreme value. I do not think its value can be exaggerated, because it gives you the means of training the young in [184] attention and accuracy, which are the two things in which all mankind are more deficient than in any other mental quality whatever. The whole of my life has been spent in trying to give my proper attention to things and to be accurate, and I have not succeeded as well as I could wish; and other people, I am afraid, are not much more fortunate. You cannot begin this habit too early, and I consider there is nothing of so great a value as the habit of drawing, to secure those two desirable ends.

Then we come to the subject-matter, whether scientific or æsthetic, of education, and I should naturally have no question at all about teaching the elements of physical science of the kind I have sketched, in a practical manner; but among scientific topics, using the word scientific in the broadest sense, I would also include the elements of the theory of morals and of that of political and social life, which, strangely enough, it never seems to occur to anybody to teach a child. I would have the history of our own country, and of all the influences which have been brought to bear upon it, with incidental geography, not as a mere chronicle of reigns and battles, but as a chapter in the development of the race, and the history of civilisation.

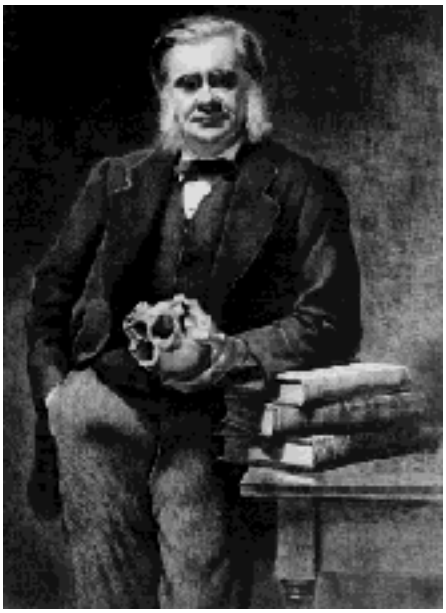
Then with respect to æsthetic knowledge and discipline, we have happily in the English language one of

the most magnificent storehouses of artistic [185] beauty and of models of literary excellence which exists in the world at the present time. I have said before, and I repeat it here, that if a man cannot get literary culture of the highest kind out of his Bible, and Chaucer, and Shakespeare, and Milton, and Hobbes, and Bishop Berkeley, to mention only a few of our illustrious writers–I say, if he cannot get it out of those writers, he cannot get it out of anything; and I would assuredly devote a very large portion of the time of every English child to the careful study of the models of English writing of such varied and wonderful kind as we possess, and, what is still more important and still more neglected, the habit of using that language with precision, with force, and with art. I fancy we are almost the only nation in the world who seem to think that composition comes by nature. The French attend to their own language, the Germans study theirs; but Englishmen do not seem to think it is worth their while. Nor would I fail to include, in the course of study I am sketching, translations of all the best works of antiquity, or of the modern world. It is a very desirable thing to read Homer in Greek; but if you don't happen to know Greek, the next best thing we can do is to read as good a translation of it as we have recently been furnished with in prose. You won't get all you would get from the original, but you may get a great deal; and to refuse to know this great deal [186] because you cannot get all, seems to be as sensible as for a hungry man to refuse bread because he cannot get partridge. Finally, I would add instruction in either music or painting, or, if the child should be so unhappy, as sometimes happens, as to have no faculty for either of those, and no possibility of doing anything in any artistic sense with them, then I would see what could be done with literature alone; but I would provide, in the fullest sense, for the development of the æsthetic side of the mind. In my judgment, those are all the essentials of education for an English child. With that outfit, such as it might be made in the time given to education which is within the reach of nine-tenths of the population–with that outfit, an Englishman, within the limits of English life, is fitted to go anywhere, to occupy the highest positions, to fill the highest offices of the State, and to become distinguished in practical pursuits, in science, or in art. For, if he have the opportunity to learn all those things, and have his mind disciplined in the various directions the teaching of those topics would have necessitated, then, assuredly, he will be able to pick up, on his road through life, all the rest of the intellectual baggage he wants.

If the educational time at our disposition were sufficient, there are one or two things I would add to those I have just now called the essentials; and perhaps you will be surprised to hear, though I [187] hope you will not, that I should add, not more science, but one, or, if possible, two languages. The knowledge of some other language than one's own is, in fact, of singular intellectual value. Many of the faults and mistakes of the ancient philosophers are traceable to the fact that they knew no language but their own, and were often led into confusing the symbol with the thought which it embodied. I think it is Locke who says that one-half of the mistakes of philosophers have arisen from questions about words; and one of the safest ways of delivering yourself from the bondage of words is, to know how ideas look in words to which you are not accustomed. That is one reason for the study of language; another reason is, that it opens new fields in art and in science. Another is the practical value of such knowledge; and yet another is this, that if your languages are properly chosen, from the time of learning the additional languages you will know your own language better than ever you did. So, I say, if the time given to education permits, add Latin and German. Latin, because it is the key to nearly one-half of English and to all the Romance languages; and German, because it is the key to almost all the remainder of English, and helps you to understand a race from whom most of us have sprung, and who have a character and a

literature of a fateful force in the history of the world, such as probably has been allotted to those of no other people, [188] except the Jews, the Greeks, and ourselves. Beyond these, the essential and the eminently desirable elements of all education, let each man take up his special line–the historian devote himself to his history, the man of science to his science, the man of letters to his culture of that kind, and the artist to his special pursuit.

Bacon has prefaced some of his works with no more than this: *Franciscsus Bacon sic cogitavit;* let "sic cogitavi" be the epilogue to what I have ventured to address to you to-night.



Universities: Actual and Ideal (1874)

Collected Essays III

[189] Elected by the suffrages of your four Nations Rector of the ancient University of which you are scholars, I take the earliest opportunity which has presented itself since my restoration to health, of delivering the Address which, by long custom, is expected of the holder of my office.

My first duty in opening that Address, is to offer you my most hearty thanks for the signal honour you have conferred upon me–an honour of which, as a man unconnected with you by personal or by national ties, devoid of political distinction, and a plebeian who stands by his order, I could not have dreamed. And it was the more surprising to me, as the five-and-twenty years which have passed over my head since I reached intellectual manhood, have been largely spent in no half-hearted advocacy of doctrines which have [190] not yet found favour in the eyes of Academic respectability; so that, when the proposal to nominate me for your Rector came, I was almost as much astonished as was Hal o' the Wynd, "who fought for his own hand," by the Black Douglas's proffer of knighthood. And I fear that my acceptance must be taken as evidence that, less wise than the Armourer of Perth, I have not yet done with soldiering.

In fact, if, for a moment, I imagined that your intention was simply, in the kindness of your hearts, to do me honour; and that the Rector of your University, like that of some other Universities was one of those happy beings who sit in glory for three years, with nothing to do for it save the making of a speech, a conversation with my distinguished predecessor soon dispelled the dream. I found that, by the constitution of the University of Aberdeen, the incumbent of the Rectorate is, if not a power, at any rate a potential energy; and that, whatever may be his chances of success or failure, it is his duty to convert that potential energy into a living force, directed towards such ends as may seem to him conducive to the welfare of the corporation of which he is the theoretical head.

I need not tell you that your late Lord Rector took this view of his position, and acted upon it with the comprehensive, far-seeing insight into the actual condition and tendencies, not merely [191] of his own, but of other countries, which is his honourable characteristic among statesmen. I have already done my best, and, as long as I hold my office, I shall continue my endeavours, to follow in the path which he trod; to do what in me lies, to bring this University nearer to the ideal–alas, that I should be obliged to say ideal–of all Universities; which, as I conceive, should be places in which thought is free from all fetters; and in which all sources of knowledge, and all aids to learning, should be accessible to all comers, without distinction of creed or country, riches or poverty.

Do not suppose, however, that I am sanguine enough to expect much to come of any poor efforts of mine. If your annals take any notice of my incumbency, I shall probably go down to posterity as the Rector who was always beaten. But if they add, as I think they will, that my defeats became victories in the hands of my successors, I shall be well content.

The scenes are shifting in the great theatre of the world. The act which commenced with the Protestant Reformation is nearly played out, and a wider and deeper change than that effected three centuries ago–a reformation, or rather a revolution of thought, the extremes of which are represented by the intellectual heirs of John of Leyden and of Ignatius Loyola, rather than by those of Luther [192] and of Leo–is waiting to come on, nay, visible behind the scenes to those who have good eyes. Men are beginning, once more, to awake to the fact that matters of belief and of speculation are of absolutely infinite practical importance; and are drawing off from that sunny country "where it is always afternoon"–the sleepy hollow of broad indifferentism–to range themselves under their natural banners. Change is in the air. It is whirling feather-heads into all sorts of eccentric orbits, and filling the steadiest with a sense of insecurity. It insists on reopening all questions and asking all institutions, however venerable, by what right they exist, and whether they are, or are not, in harmony with the real or supposed wants of mankind. And it is remarkable that these searching inquiries are not so much forced on institutions from without, as developed from within. Consummate scholars question the value of learning; priests contemn dogma; and women turn their backs upon man's ideal of perfect womanhood, and seek satisfaction in apocalyptic visions of some, as yet, unrealised epicene reality.

If there be a type of stability in this world, one would be inclined to look for it in the old Universities of England. But it has been my business of late to hear a good deal about what is going on in these famous corporations; and I have been filled with astonishment by the evidences of internal fermentation which they exhibit. If Gibbon [193] could revisit the ancient seat of learning of which he has written so cavalierly, assuredly he would no longer speak of "the monks of Oxford sunk in prejudice and port." There, as elsewhere, port has gone out of fashion, and so has prejudice–at least that particular fine, old, crusted sort of prejudice to which the great historian alludes.

Indeed, things are moving so fast in Oxford and Cambridge, that, for my part, I rejoiced when the Royal Commission, of which I am a member, had finished and presented the Report which related to these Universities; for we should have looked like mere plagiarists, if, in consequence of a little longer delay in issuing it, all the measures of reform we proposed had been anticipated by the spontaneous action of the Universities themselves.

A month ago I should have gone on to say that one might speedily expect changes of another kind in Oxford and Cambridge. A Commission has been inquiring into the revenues of the many wealthy societies, in more or less direct connection with the Universities, resident in those towns. It is said that the Commission has reported, and that, for the first time in recorded history, the nation, and perhaps the Colleges themselves, will know what they are worth. And it was announced that a statesman, who, whatever his other merits or defects, has aims above the level of mere party fighting, and a clear vision into the most complex [194] practical problems, meant to deal with these revenues.

But, *Bos locutus est.* That mysterious independent variable of political calculation, Public Opinion–which some whisper is, in the present case, very much the same thing as publican's opinion–has willed otherwise. The Heads may return to their wonted slumbers–at any rate for a space.

Is the spirit of change, which is working thus vigorously in the South, likely to affect the Northern Universities, and if so, to what extent? The violence of fermentation depends, not so much on the quantity of the yeast, as on the composition of the wort, and its richness in fermentable material; and, as a preliminary to the discussion of this question, I venture to call to your minds the essential and fundamental differences between the Scottish and the English type of University.

Do not charge me with anything worse than official egotism, if I say that these differences appear to be largely symbolised by my own existence. There is no Rector in an English University. Now, the organisation of the members of a University into Nations, with their elective Rector, is the last relic of the primitive constitution of Universities. The Rectorate was the most important of all offices in that University of Paris, upon the model of which the University [195] of Aberdeen was fashioned; and which was certainly a great and flourishing institution in the twelfth century.

Enthusiasts for the antiquity of one of the two acknowledged parents of all Universities, indeed, do not hesitate to trace the origin of the "Studium Parisiense" up to that wonderful king of the Franks and Lombards, Karl, surnamed the Great, whom we all called Charlemagne, and believed to be a Frenchman, until a learned historian, by beneficent iteration, taught us better. Karl is said not to have been much of a scholar himself, but he had the wisdom of which knowledge is only the servitor. And that wisdom enabled him to see that ignorance is one of the roots of all evil.

In the Capitulary which enjoins the foundation of monasterial and cathedral schools, he says: "Right action is better than knowledge; but in order to do what is right, we must know what is right."[1] An irrefragable truth, I fancy. Acting upon it, the king took pretty full compulsory powers, and carried into effect a really considerable and effectual scheme of elementary education through the length and breadth of his dominions.

No doubt the idolaters out by the Elbe, in what [196] is now part of Prussia, objected to the Frankish king's measures; no doubt the priests, who had never hesitated about sacrificing all unbelievers in their fantastic deities and futile conjurations, were the loudest in chanting the virtues of toleration; no doubt they denounced as a cruel persecutor the man who would not allow them, however sincere they might be, to go on spreading delusions which debased the intellect, as much as they deadened the moral sense, and undermined the bonds of civil allegiance; no doubt, if they had lived in these times, they would have been able to show, with ease, that the king's proceedings were totally contrary to the best liberal principles. But it may be said, in justification of the Teutonic ruler, first, that he was born before those principles, and did not suspect that the best way of getting disorder into order was to let it alone; and, secondly, that his rough and questionable proceedings did, more or less, bring about the end he had in view. For, in a couple of centuries, the schools he sowed broadcast produced their crop of men, thirsting for knowledge and craving for culture. Such men gravitating towards Paris, as a light amidst the darkness of evil days, from Germany, from Spain, from Britain, and from Scandinavia, came together by natural affinity. By degrees they banded themselves into a society, which, as its end was the knowledge of all things knowable, called itself a "*Studium Generale;*" [197] and when it had grown into a recognised corporation, acquired the name of "*Universitas Studii Generalis,*" which, mark you, means

not a "Useful Knowledge Society," but a "Knowledge-of-things-in-general Society."

And thus the first "University," at any rate on this side of the Alps, came into being. Originally it had but one Faculty, that of Arts. Its aim was to be a centre of knowledge and culture; not to be, in any sense, a technical school.

The scholars seem to have studied Grammar, Logic, and Rhetoric; Arithmetic and Geometry; Astronomy; Theology; and Music. Thus, their work, however imperfect and faulty, judged by modern lights, it may have been, brought them face to face with all the leading aspects of the many-sided mind of man. For these studies did really contain, at any rate in embryo–sometimes, it may be, in caricature–what we now call Philosophy, Mathematical and Physical Science, and Art. And I doubt if the curriculum of any modern University shows so clear and generous a comprehension of what is meant by culture, as this old Trivium and Quadrivium does.

The students who had passed through the University course, and had proved themselves competent to teach, became masters and teachers of their younger brethren. Whence the distinction of Masters and Regents on the one hand, and Scholars on the other.

[198] Rapid growth necessitated organisation. The Masters and Scholars of various tongues and countries grouped themselves into four Nations; and the Nations, by their own votes at first, and subsequently by those of their Procurators, or representatives, elected their supreme head and governor, the Rector–at that time the sole representative of the University, and a very real power, who could defy Provosts interfering from without; or could inflict even corporal punishment on disobedient members within the University.

Such was the primitive constitution of the University of Paris. It is in reference to this original state of things that I have spoken of the Rectorate, and all that appertains to it, as the sole relic of that constitution.

But this original organisation did not last long. Society was not then, any more than it is now, patient of culture, as such. It says to everything, "Be useful to me, or away with you." And to the learned, the unlearned man said then, as he does now, "What is the use of all your learning, unless you can tell me what I want to know? I am here blindly groping about, and constantly damaging myself by collision with three mighty powers, the power of the invisible God, the power of my fellow Man, and the power of brute Nature. Let your learning be turned to the study of these powers, that I may know how I am to comport myself with regard to them." In answer to this [199] demand, some of the Masters of the Faculty of Arts devoted themselves to the study of Theology, some to that of Law, and some to that of Medicine; and they became Doctors–men learned in those technical, or, as we now call them, professional, branches of knowledge. Like cleaving to like, the Doctors formed schools, or Faculties, of Theology, Law, and Medicine, which sometimes assumed airs of superiority over their parent, the Faculty of Arts, though the latter always asserted and maintained its fundamental supremacy.

The Faculties arose by process of natural differentiation out of the primitive University. Other constituents, foreign to its nature, were speedily grafted upon it. One of these extraneous elements was forced into it by the Roman Church, which in those days asserted with effect, that which it now asserts, happily without any effect in these realms, its right of censorship and control over all teaching. The local habitation of the University lay partly in the lands attached to the monastery of S. Geneviève, partly in the diocese of the Bishop of Paris; and he who would teach must have the licence of the Abbot, or of the Bishop, as the nearest representative of the Pope, so to do, which licence was granted by the Chancellors of these Ecclesiastics.

Thus, if I am what archæologists call a "survival" of the primitive head and ruler of the University, your Chancellor stands in the same [200] relation to the Papacy; and, with all respect for his Grace, I think I may say that we both look terribly shrunken when compared with our great originals.

Not so is it with a second foreign element, which silently dropped into the soil of Universities, like the grain of mustard-seed in the parable; and, like that grain, grew into a tree, in whose branches a whole aviary of fowls took shelter. That element is the element of Endowment. It differed from the preceding, in its original design to serve as a prop to the young plant, not to be a parasite upon it. The charitable and the humane, blessed with wealth, were very early penetrated by the misery of the poor student. And the wise saw that intellectual ability is not so common or so unimportant a gift that it should be allowed to run to waste upon mere handicrafts and chares. The man who was a blessing to his contemporaries, but who so often has been converted into a curse, by the blind adherence of his posterity to the letter, rather than to the spirit, of his wishes–I mean the "pious founder"–gave money and lands, that the student, who was rich in brain and poor in all else, might be taken from the plough or from the stithy, and enabled to devote himself to the higher service of mankind; and built colleges and halls in which he might be not only housed and fed, but taught.

The Colleges were very generally placed in [201] strict subordination to the University by their founders; but, in many cases, their endowment, consisting of land, has undergone an "unearned increment," which has given these societies a continually increasing weight and importance as against the unendowed, or fixedly endowed, University. In Pharaoh's dream, the seven lean kine eat up the seven fat ones. In the reality of historical fact, the fat Colleges have eaten up the lean Universities.

Even here in Aberdeen, though the causes at work may have been somewhat different, the effects have been similar; and you see how much more substantial an entity is the Very Reverend the Principal, analogue, if not homologue, of the Principals of King's College, than the Rector, lineal representative of the ancient monarchs of the University, though now, little more than a "king of shreds and patches."

Do not suppose that, in thus briefly tracing the process of University metamorphosis, I have had any intention of quarrelling with its results. Practically, it seems to me that the broad changes effected in 1858 have given the Scottish Universities a very liberal constitution, with as much real approximation to the primitive state of things as is at all desirable. If your fat kine have eaten the lean, they have not lain down to chew the cud ever since. The Scottish Universities, like the English, have diverged widely

enough from their [202] primitive model; but I cannot help thinking that the northern form has remained more faithful to its original, not only in constitution, but, what is more to the purpose, in view of the cry for change, in the practical application of the endowments connected with it.

In Aberdeen, these endowments are numerous, but so small that, taken altogether, they are not equal to the revenue of a single third-rate English college. They are scholarships, not fellowships; aids to do work–not rewards for such work as it lies within the reach of an ordinary, or even an extraordinary, young man to do. You do not think that passing a respectable examination is a fair equivalent for an income, such as many a grey-headed veteran, or clergyman would envy; and which is larger than the endowment of many Regius chairs. You do not care to make your University a school of manners for the rich; of sports for the athletic; or a hot-bed of high-fed, hypercritical refinement, more destructive to vigour and originality than are starvation and oppression. No; your little Bursaries of ten and twenty (I believe even fifty) pounds a year, enabled any boy who has shown ability in the course of his education in those remarkable primary schools, which have made Scotland the power she is, to obtain the highest culture the country can give him; and when he is armed and equipped, his Spartan Alma Mater tells him that, so far, he has had his [203] wages for his work, and that he may go and earn the rest.

When I think of the host of pleasant, moneyed, well-bred young gentlemen, who do a little learning and much boating by Cam and Isis, the vision is a pleasant one; and, as a patriot, I rejoice that the youth of the upper and richer classes of the nation receive a wholesome and a manly training, however small may be the modicum of knowledge they gather, in the intervals of this, their serious business. I admit, to the full, the social and political value of that training. But, when I proceed to consider that these young men may be said to represent the great bulk of what the Colleges have to show for their enormous wealth, plus, at least, a hundred and fifty pounds a year apiece which each undergraduate costs his parents or guardians, I feel inclined to ask, whether the rate-in-aid of the education of the wealthy and professional classes, thus levied on the resources of the community, is not, after all, a little heavy? And, still further, I am tempted to inquire what has become of the indigent scholars, the sons of the masses of the people whose daily labour just suffices to meet their daily wants, for whose benefit these rich foundations were largely, if not mainly, instituted? It seems as if Pharaoh's dream had been rigorously carried out, and that even the fat scholar has eaten the lean one. And when I turn from this picture to the no less real [204] vision of many a brave and frugal Scotch boy, spending his summer in hard manual labour, that he may have the privilege of wending his way in autumn to this University, with a bag of oatmeal, ten pounds in his pocket, and his own stout heart to depend upon through the northern winter; not bent on seeking

"The bubble reputation at the cannon's mouth,"

but determined to wring knowledge from the hard hands of penury; when I see him win through all such outward obstacles to positions of wide usefulness and well-earned fame; I cannot but think that, in essence, Aberdeen has departed but little from the primitive intention of the founders of Universities, and that the spirit of reform has so much to do on the other side of the Border, that it may be long before he has leisure to look this way.

As compared with other actual Universities, then, Aberdeen, may, perhaps, be well satisfied with itself.

But do not think me an impracticable dreamer, if I ask you not to rest and be thankful in this state of satisfaction; if I ask you to consider awhile, how this actual good stands related to that ideal better, towards which both men and institutions must progress, if they would not retrograde.

In an ideal University, as I conceive it, a man should be able to obtain instruction in all forms [205] of knowledge, and discipline in the use of all the methods by which knowledge is obtained. In such a University, the force of living example should fire the student with a noble ambition to emulate the learning of learned men, and to follow in the footsteps of the explorers of new fields of knowledge. And the very air he breathes should be charged with that enthusiasm for truth, that fanaticism of veracity, which is a greater possession than much learning; a nobler gift than the power of increasing knowledge; by so much greater and nobler than these, as the moral nature of man is greater than the intellectual; for veracity is the heart of morality.

But the man who is all morality and intellect, although he may be good and even great, is, after all, only half a man. There is beauty in the moral world and in the intellectual world; but there is also a beauty which is neither moral nor intellectual–the beauty of the world of Art. There are men who are devoid of the power of seeing it, as there are men who are born deaf and blind, and the loss of those, as of these, is simply infinite. There are others in whom it is an overpowering passion; happy men, born with the productive, or at lowest, the appreciative, genius of the Artist. But, in the mass of mankind, the Æsthetic faculty, like the reasoning power and the moral sense, needs to be roused, directed, and cultivated; and I know not why the develop[206]ment of that side of his nature, through which man has access to a perennial spring of ennobling pleasure, should be omitted from any comprehensive scheme of University education.

All Universities recognise Literature in the sense of the old Rhetoric, which is art incarnate in words. Some, to their credit, recognise Art in its narrower sense, to a certain extent, and confer degrees for proficiency in some of its branches. If there are Doctors of Music, why should there be no Masters of painting, of Sculpture, of Architecture? I should like to see Professors of the Fine Arts in every University; and instruction in some branch of their work made a part of the Arts curriculum.

I just now expressed the opinion that, in our ideal University, a man should be able to obtain instruction in all forms of knowledge. Now, by "forms of knowledge" I mean the great classes of things knowable; of which the first, in logical, though not in natural, order is knowledge relating to the scope and limits of the mental faculties of man, a form of knowledge which, in its positive aspect, answers pretty much to Logic and part of Psychology, while, on its negative and critical side, it corresponds with Metaphysics.

A second class comprehends all that knowledge which relates to man's welfare, so far as it is determined by his own acts, or what we call his conduct. It answers to Moral and Religious philo[207]sophy. Practically, it is the most directly valuable of all forms of knowledge, but speculatively, it is limited and criticised by that which precedes and by that which follows it in my order of enumeration.

A third class embraces knowledge of the phænomena of the Universe, as that which lies about the

individual man; and of the rules which those phænomena are observed to follow in the order of their occurrence, which we term the laws of Nature.

This is what ought to be called Natural Science, or Physiology, though those terms are hopelessly diverted from such a meaning; and it includes all exact knowledge of natural fact, whether Mathematical, Physical, Biological, or Social.

Kant has said that the ultimate object of all knowledge is to give replies to these three questions: What can I do? What ought I to do? What may I hope for? The forms of knowledge which I have enumerated, should furnish such replies as are within human reach, to the first and second of these questions. While to the third, perhaps the wisest answer is, "Do what you can to do what you ought, and leave hoping and fearing alone."

If this be a just and an exhaustive classification of the forms of knowledge, no question as to their relative importance, or as to the superiority of one to the other, can be seriously raised.

[208] On the face of the matter, it is absurd to ask whether it is more important to know the limits of one's powers; or the ends for which they ought to be exerted; or the conditions under which they must be exerted. One may as well inquire which of the terms of a Rule of Three sum one ought to know, in order to get a trustworthy result. Practical life is such a sum, in which your duty multiplied into your capacity, and divided by your circumstances, gives you the fourth term in the proportion, which is your deserts, with great accuracy. All agree, I take it, that men ought to have these three kinds of knowledge. The so-called "conflict of studies" turns upon the question of how they may best be obtained.

The founders of Universities held the theory that the Scriptures and Aristotle taken together, the latter being limited by the former, contained all knowledge worth having, and that the business of philosophy was to interpret and co-ordinate these two. I imagine that in the twelfth century this was a very fair conclusion from known facts. Nowhere in the world, in those days, was there such an encyclopædia of knowledge of all three classes, as is to be found in those writings. The scholastic philosophy is a wonderful monument of the patience and ingenuity with which the human mind toiled to build up a logically consistent theory of the Universe, out of such materials. And that philosophy is by no means dead and [209] buried, as many vainly suppose. On the contrary, numbers of men of no mean learning and accomplishment, and sometimes of rare power and subtlety of thought, hold by it as the best theory of things which has yet been stated. And, what is still more remarkable, men who speak the language of modern philosophy, nevertheless think the thoughts of the schoolmen. "The voice is the voice of Jacob, but the hands are the hands of Esau." Every day I hear "Cause," "Law," "Force," "Vitality," spoken of as entities, by people who can enjoy Swift's joke about the meat-roasting quality of the smoke-jack, and comfort themselves with the reflection that they are not even as those benighted schoolmen.

Well, this great system had its day, and then it was sapped and mined by two influences. The first was the study of classical literature, which familiarised men with methods of philosophising; with conceptions of the highest Good; with ideas of the order of Nature; with notions of Literary and

Historical Criticism; and, above all, with visions of Art, of a kind which not only would not fit into the scholastic scheme, but showed them a pre-Christian, and indeed altogether un-Christian world, of such grandeur and beauty that they ceased to think of any other. They were as men who had kissed the Fairy Queen, and wandering with her in the dim loveliness of the under-world, [210] cared not to return to the familiar ways of home and fatherland, though they lay, at arm's length, overhead. Cardinals were more familiar with Virgil than with Isaiah; and Popes laboured, with great success, to re-paganise Rome.

The second influence was the slow, but sure, growth of the physical sciences. It was discovered that some results of speculative thought, of immense practical and theoretical importance, can be verified by observation; and are always true, however severely they may be tested. Here, at any rate, was knowledge, to the certainty of which no authority could add, or take away, one jot or tittle, and to which the tradition of a thousand years was as insignificant as the hearsay of yesterday. To the scholastic system, the study of classical literature might be inconvenient and distracting, but it was possible to hope that it could be kept within bounds. Physical science, on the other hand, was an irreconcilable enemy, to be excluded at all hazards. The College of Cardinals has not distinguished itself in Physics or Physiology; and no Pope has, as yet, set up public laboratories in the Vatican.

People do not always formulate the beliefs on which they act. The instinct of fear and dislike is quicker than the reasoning process; and I suspect that, taken in conjunction with some other causes, such instinctive aversion is at the [211] bottom of the long exclusion of any serious discipline in the physical sciences from the general curriculum of Universities; while, on the other hand, classical literature has been gradually made the backbone of the Arts course.

I am ashamed to repeat here what I have said elsewhere, in season and out of season, respecting the value of Science as knowledge and discipline. But the other day I met with some passages in the Address to another Scottish University, of a great thinker, recently lost to us, which express so fully and yet so tersely, the truth in this matter that I am fain to quote them:–

"To question all things;–never to turn away from any difficulty; to accept no doctrine either from ourselves or from other people without a rigid scrutiny by negative criticism; letting no fallacy, or incoherence, or confusion of thought, step by unperceived; above all, to insist upon having the meaning of a word clearly understood before using it, and the meaning of a proposition before assenting to it;–these are the lessons we learn" from workers in Science. "With all this vigorous management of the negative element, they inspire no scepticism about the reality of truth or indifference to its pursuit. The noblest enthusiasm, both for the search after truth and for applying it to its highest uses, pervades those writers." "In cultivating, therefore," science as an essential ingredient in education," we are all the while [212] laying an admirable foundation for ethical and philosophical culture."[2]

The passages I have quoted were uttered by John Stuart Mill; but you cannot hear inverted commas, and it is therefore right that I should add, without delay, that I have taken the liberty of substituting "workers in science" for "ancient dialecticians," and "Science as an essential ingredient in education" for "the ancient languages as our best literary education." Mill did, in fact, deliver a noble panegyric upon

classical studies. I do not doubt its justice, nor presume to question its wisdom. But I venture to maintain that no wise or just judge, who has a knowledge of the facts, will hesitate to say that it applies with equal force to scientific training.

But it is only fair to the Scottish Universities to point out that they have long understood the value of Science as a branch of general education. I observe, with the greatest satisfaction, that candidates for the degree of Master of Arts in this University are required to have a knowledge, not only of Mental and Moral Philosophy, and of Mathematics and Natural Philosophy, but of Natural History, in addition to the ordinary Latin and Greek course; and that a candidate may take honours in these subjects and in Chemistry.

[213] I do not know what the requirements of your examiners may be, but I sincerely trust they are not satisfied with a mere book knowledge of these matters. For my own part I would not raise a finger, if I could thereby introduce mere book work in science into every Arts curriculum in the country. Let those who want to study books devote themselves to Literature, in which we have the perfection of books, both as to substance and as to form. If I may paraphrase Hobbes's well-known aphorism, I would say that "books are the money of Literature, but only the counters of Science," Science (in the sense in which I now use the term) being the knowledge of fact, of which every verbal description is but an incomplete and symbolic expression. And be assured that no teaching of science is worth anything, as a mental discipline, which is not based upon direct perception of the facts, and practical exercise of the observing and logical faculties upon them. Even in such a simple matter as the mere comprehension of form, ask the most practised and widely informed anatomist what is the difference between his knowledge of a structure which he has read about, and his knowledge of the same structure when he has seen it for himself; and he will tell you that the two things are not comparable–the difference is infinite. Thus I am very strongly inclined to agree with some learned schoolmasters who say that, in their experience, the teaching of science is all waste time. [214] As they teach it, I have no doubt it is. But to teach it otherwise requires an amount of personal labour and a development of means and appliances, which must strike horror and dismay into a man accustomed to mere book work; and who has been in the habit of teaching a class of fifty without much strain upon his energies. And this is one of the real difficulties in the way of the introduction of physical science into the ordinary University course, to which I have alluded. It is a difficulty which will not be overcome, until years of patient study have organised scientific teaching as well as, or I hope better than, classical teaching has been organised hitherto.

A little while ago, I ventured to hint a doubt as to the perfection of some of the arrangements in the ancient Universities of England; but, in their provision for giving instruction in Science as such, and without direct reference to any of its practical applications, they have set a brilliant example. Within the last twenty years, Oxford alone has sunk more than a hundred and twenty thousand pounds in building and furnishing Physical, Chemical, and Physiological Laboratories, and a magnificent Museum, arranged with an almost luxurious regard for the needs of the student. Cambridge, less rich, but aided by the munificence of her Chancellor, is taking the same course; and in a few years, it will be for no lack of the means and appliances of sound teaching, if the mass of [215] English University men remain in their present state of barbarous ignorance of even the rudiment of scientific culture.

Yet another step needs to be made before Science can be said to have taken its proper place in the Universities. That is its recognition as a Faculty, or branch of study demanding recognition and special organisation, on account of its bearing on the wants of mankind. The Faculties of Theology, Law, and Medicine, are technical schools, intended to equip men who have received general culture, with the special knowledge which is needed for the proper performance of the duties of clergymen, lawyers, and medical practitioners.

When the material well-being of the country depended upon rude pasture and agriculture, and still ruder mining; in the days when all the innumerable applications of the principles of physical science to practical purposes were non-existent even as dreams; days which men living may have heard their fathers speak of; what little physical science could be seen to bear directly upon human life, lay within the province of Medicine. Medicine was the foster-mother of Chemistry, because it has to do with the preparation of drugs and the detection of poisons; of Botany, because it enabled the physician to recognise medicinal herbs; of Comparative Anatomy and Physiology, because the man who studied Human Anatomy and Physiology for purely [216] medical purposes was led to extend his studies to the rest of the animal world.

Within my recollection, the only way in which a student could obtain anything like a training in Physical Science, was by attending the lectures of the Professors of Physical and Natural Science attached to the Medical Schools. But, in the course of the last thirty years, both foster-mother and child have grown so big, that they threaten not only to crush one another, but to press the very life out of the unhappy student who enters the nursery; to the great detriment of all three.

I speak in the presence of those who know practically what medical education is; for I may assume that a large proportion of my hearers are more or less advanced students of medicine. I appeal to the most industrious and conscientious among you, to those who are most deeply penetrated with a sense of the extremely serious responsibilities which attach to the calling of a medical practitioner, when I ask whether, out of the four years which you devote to your studies, you ought to spare even so much as an hour for any work which does not tend directly to fit you for your duties?

Consider what that work is. Its foundation is a sound and practical acquaintance with the structure of the human organism, and with the modes and conditions of its action in health. I say a sound and practical acquaintance, to guard against the [217] supposition that my intention is to suggest that you ought all to be minute anatomists and accomplished physiologists. The devotion of your whole four years to Anatomy and Physiology alone, would be totally insufficient to attain that end. What I mean is, the sort of practical, familiar, finger-end knowledge which a watchmaker has of a watch, and which you expect that craftsman, as an honest man, to have, when you entrust a watch that goes badly, to him. It is a kind of knowledge which is to be acquired, not in the lecture-room, nor in the library, but in the dissecting-room and the laboratory. It is to be had not by sharing your attention between these and sundry other subjects, but by concentrating your minds, week after week, and month after month, six or seven hours a day, upon all the complexities of organ and function, until each of the greater truths of anatomy and physiology has become an organic part of your minds–until you would know them if you were roused

and questioned in the middle of the night, as a man knows the geography of his native place and the daily life of his home. That is the sort of knowledge which, once obtained, is a life-long possession. Other occupations may fill your minds–it may grow dim, and seem to be forgotten–but there it is, like the inscription on a battered and defaced coin, which comes out when you warm it.

[218] If I had the power to remodel Medical Education, the first two years of the medical curriculum should be devoted to nothing but such thorough study of Anatomy and Physiology, with Physiological Chemistry and Physics; the student should then pass a real, practical examination in these subjects; and, having gone through that ordeal satisfactorily, he should be troubled no more with them. His whole mind should then be given with equal intentness to Therapeutics, in its broadest sense, to Practical Medicine and to Surgery, with instruction in Hygiene and in Medical Jurisprudence; and of these subjects only–surely there are enough of them–should he be required to show a knowledge in his final examination.

I cannot claim any special property in this theory of what the medical curriculum should be, for I find that views, more or less closely approximating these, are held by all who have seriously considered the very grave and pressing question of Medical Reform; and have, indeed, been carried into practice, to some extent, by the most enlightened Examining Boards. I have heard but two kinds of objections to them. There is first, the objection of vested interests, which I will not deal with here, because I want to make myself as pleasant as I can, and no discussions are so unpleasant as those which turn on such points. And there is, secondly, the much more respectable [219] objection, which takes the general form of the reproach that, in thus limiting the curriculum, we are seeking to narrow it. We are told that the medical man ought to be a person of good education and general information, if his profession is to hold its own among other professions; that he ought to know Botany, or else, if he goes abroad, he will not be able to tell poisonous fruits from edible ones; that he ought to know drugs, as a druggist knows them, or he will not be able to tell sham bark and senna from the real articles; that he ought to know Zoology, because–well, I really have never been able to learn exactly why he is to be expected to know zoology. There is, indeed, a popular superstition, that doctors know all about things that are queer or nasty to the general mind, and may, therefore, be reasonably expected to know the "barbarous binomials" applicable to snakes, snails, and slugs; an amount of information with which the general mind is usually completely satisfied. And there is a scientific superstition that Physiology is largely aided by Comparative Anatomy–a superstition which, like most superstitions, once had a grain of truth at bottom; but the grain has become homœopathic, since Physiology took its modern experimental development, and became what it is now, the application of the principles of Physics and Chemistry to the elucidation of the phænomena of life.

I hold as strongly as any one can do, that the [220] medical practitioner ought to be a person of education and good general culture; but I also hold by the old theory of a Faculty, that a man should have his general culture before he devotes himself to the special studies of that Faculty; and I venture to maintain, that, if the general culture obtained in the Faculty of Arts were what it ought to be, the student would have quite as much knowledge of the fundamental principles of Physics, of Chemistry, and of Biology, as he needs, before he commenced his special medical studies.

Moreover, I would urge, that a thorough study of Human Physiology is, in itself, an education broader and more comprehensive than much that passes under that name. There is no side of the intellect which it does not call into play, no region of human knowledge into which either its roots, or its branches, do not extend; like the Atlantic between the Old and the New Worlds, its waves wash the shores of the two worlds of matter and of mind; its tributary streams flow from both; through its waters, as yet unfurrowed by the keel of any Columbus, lies the road, if such there be, from the one to the other; far away from that North-west Passage of mere speculation, in which so many brave souls have been hopelessly frozen up.

But whether I am right or wrong about all this, the patent fact of the limitation of time remains. As the song runs:–

> [221] "If a man could be sure
> That his life would endure
> For the space of a thousand long years–"

he might do a number of things not practicable under present conditions. Methuselah might, with much propriety, have taken half a century to get his doctor's degree; and might, very fairly, have been required to pass a practical examination upon the contents of the British Museum, before commencing practice as a promising young fellow of two hundred, or thereabouts. But you have four years to do your work in, and are turned loose, to save or slay, at two or three and twenty.

Now, I put it to you, whether you think that, when you come down to the realities of life–when you stand by the sick-bed, racking your brains for the principles which shall furnish you with the means of interpreting symptoms, and forming a rational theory of the condition of your patient, it will be satisfactory for you to find that those principles are not there–although, to use the examination slang which is unfortunately too familiar to me, you can quite easily "give an account of the leading peculiarities of the *Marsupialia*," or "enumerate the chief characters of the *Compositæ*," or "state the class and order of the animal from which Castoreum is obtained"

I really do not think that state of things will be satisfactory to you; I am very sure it will not be so to your patient. Indeed, I am so narrow-[222]minded myself, that if I had to choose between two physicians–one who did not know whether a whale is a fish or not, and could not tell gentian from ginger, but did understand the applications of the institutes of medicine to his art; while the other, like Talleyrand's doctor, "knew everything, even a little physic"–with all my love for breadth of culture, I should assuredly consult the former.

It is not pleasant to incur the suspicion of an inclination to injure or depreciate particular branches of knowledge. But the fact that one of those which I should have no hesitation in excluding from the medical curriculum, is that to which my own life has been specially devoted, should, at any rate, defend me from the suspicion of being urged to this course by any but the very gravest considerations of the public welfare.

And I should like, further, to call your attention to the important circumstance that, in thus proposing the exclusion of the study of such branches of knowledge as Zoology and Botany, from those compulsory upon the medical student, I am not, for a moment, suggesting their exclusion from the University. I think that sound and practical instruction in the elementary facts and broad principles of Biology should form part of the Arts Curriculum: and here, happily, my theory is in entire accordance with your practice, Moreover, as I have already said, I have no sort of doubt [223] that, in view of the relation of Physical Science to the practical life of the present day, it has the same right as Theology, Law, and Medicine, to a Faculty of its own in which men shall be trained to be professional men of science. It may be doubted whether Universities are the places for technical schools of Engineering or applied Chemistry, or Agriculture. But there can surely be little question, that instruction in the branches of Science which lie at the foundation of these Arts, of a far more advanced and special character than could, with any propriety, be included in the ordinary Arts curriculum, ought to be obtainable by means of a duly organised Faculty of Science in every University.

The establishment of such a Faculty would have the additional advantage of providing, in some measure, for one of the greatest wants of our time and country. I mean the proper support and encouragement of original research.

The other day, an emphatic friend of mine committed himself to the opinion that, in England, it is better for a man's worldly prospects to be a drunkard, than to be smitten with the divine dipsomania of the original investigator. I am inclined to think he was not far wrong. And, be it observed, that the question is not, whether such a man shall be able to make as much out of his abilities as his brother, of like ability, who goes into Law, or Engineering, or Commerce; it is not a question of [224] "maintaining a due number of saddle horses," as George Eliot somewhere puts it–it is a question of living or starving.

If a student of my own subject shows power and originality, I dare not advise him to adopt a scientific career; for, supposing he is able to maintain himself until he has attained distinction, I cannot give him the assurance that any amount of proficiency in the Biological Sciences will be convertible into, even the most modest, bread and cheese. And I believe that the case is as bad, or perhaps worse, with other branches of Science. In this respect Britain, whose immense wealth and prosperity hang upon the thread of Applied Science, is far behind France, and infinitely behind Germany.

And the worst of it is, that it is very difficult to see one's way to any immediate remedy for this state of affairs which shall be free from a tendency to become worse than the disease.

Great schemes for the Endowment of Research have been proposed. It has been suggested, that Laboratories for all branches of Physical Science, provided with every apparatus needed by the investigator, shall be established by the State: and shall be accessible, under due conditions and regulations, to all properly qualified persons. I see no objection to the principle of such a proposal. If it be legitimate to spend great sums of money on public Libraries and public collections of Painting [225] and Sculpture, in aid of the Man of Letters, or the Artist, or for the mere sake of affording pleasure to the general public. I apprehend that it cannot be illegitimate to do as much for the promotion of scientific

investigation. To take the lowest ground, as a mere investment of money, the latter is likely to be much more immediately profitable. To my mind, the difficulty in the way of such schemes is not theoretical, but practical. Given the laboratories, how are the investigators to be maintained? What career is open to those who have been thus encouraged to leave bread-winning pursuits? If they are to be provided for by endowment, we come back to the College Fellowship system, the results of which, for Literature, have not been so brilliant that one would wish to see it extended to Science; unless some much better securities than at present exist can be taken that it will foster real work. You know that among the Bees, it depends on the kind of cell in which the egg is deposited, and the quantity and quality of food which is supplied to the grub, whether it shall turn out a busy little worker or a big idle queen. And, in the human hive, the cells of the endowed larvæ are always tending to enlarge, and their food to improve, until we get queens, beautiful to behold, but which gather no honey and build no comb.

I do not say that these difficulties may not be overcome, but their gravity is not to be lightly estimated.

[226] In the meanwhile, there is one step in the direction of the endowment of research which is free from such objections. It is possible to place the scientific enquirer in a position in which he shall have ample leisure and opportunity for original work, and yet shall give a fair and tangible equivalent for those privileges. The establishment of a Faculty of Science in every University, implies that of a corresponding number of Professorial chairs, the incumbents of which need not be so burdened with teaching as to deprive them of ample leisure for original work. I do not think that it is any impediment to an original investigator to have to devote a moderate portion of his time to lecturing, or superintending practical instruction. On the contrary, I think it may be, and often is, a benefit to be obliged to take a comprehensive survey of your subject; or to bring your results to a point, and give them, as it were, a tangible objective existence. The besetting sins of the investigator are two: the one is the desire to put aside a subject, the general bearings of which he has mastered himself, and pass on to something which has the attraction of novelty; and the other, the desire for too much perfection, which leads him to

> "Add and alter many times,
> Till all be ripe and rotten;"
> to spend the energies which should be reserved for action in whitening the decks and polishing the guns.

[227] The obligation to produce results for the instruction of others, seems to me to be a more effectual check on these tendencies than even the love of usefulness or the ambition for fame.

But supposing the Professorial forces of our University to be duly organised, there remains an important question, relating to the teaching power, to be considered. Is the Professorial system–the system, I mean, of teaching in the lecture-room alone, and leaving the student to find his own way when he is outside the lecture-room–adequate to the wants of learners? In answering this question, I confine myself to my own province, and I venture to reply for Physical Science, assuredly and undoubtedly, No. As I have already intimated, practical work in the Laboratory is absolutely indispensable, and that practical work must be guided and superintended by a sufficient staff of Demonstrators, who are for Science what Tutors are for

other branches of study. And there must be a good supply of such Demonstrators. I doubt if the practical work of more than twenty students can be properly superintended by one Demonstrator. If we take the working day at six hours, that is less than twenty minutes apiece–not a very large allowance of time for helping a dull man, for correcting an inaccurate one, or even for making an intelligent student clearly apprehend what he is about. And, no doubt, the supplying of a proper amount of this tutorial, practical [228] teaching, is a difficulty in the way of giving proper instruction in Physical Science in such Universities as that of Aberdeen, which are devoid of endowments; and, unlike the English Universities, have no moral claim on the funds of richly endowed bodies to supply their wants.

Examination–thorough, searching examination–is an indispensable accompaniment of teaching; but I am almost inclined to commit myself to the very heterodox proposition that it is a necessary evil. I am a very old Examiner, having, for some twenty years past, been occupied with examinations on a considerable scale, of all sorts and conditions of men, and women too,–from the boys and girls of elementary schools to the candidates for Honours and Fellowships in the Universities. I will not say that, in this case as in so many others, the adage, that familiarity breeds contempt, holds good; but my admiration for the existing system of examination and its products, does not wax warmer as I see more of it. Examination, like fire, is a good servant, but a bad master; and there seems to me to be some danger of its becoming our master. I by no means stand alone in this opinion. Experienced friends of mine do not hesitate to say that students whose career they watch, appear to them to become deteriorated by the constant effort to pass this or that examination, just as we hear of men's brains becoming affected by the daily necessity of catching a train. They work to pass, not [229] to know; and outraged Science takes her revenge. They do pass, and they don't know. I have passed sundry examinations in my time, not without credit, and I confess I am ashamed to think how very little real knowledge underlay the torrent of stuff which I was able to pour out on paper. In fact, that which examination, as ordinarily conducted, tests, is simply a man's power of work under stimulus, and his capacity for rapidly and clearly producing that which, for the time, he has got into his mind. Now, these faculties are by no means to be despised. They are of great value in practical life, and are the making of many an advocate, and of many a so-called statesman. But in the pursuit of truth, scientific or other, they count for very little, unless they are supplemented by that long-continued, patient "intending of the mind," as Newton phrased it, which makes very little show in Examinations. I imagine that an Examiner who knows his students personally, must not unfrequently have found himself in the position of finding A's paper better than B's, though his own judgment tells him, quite clearly, that B is the man who has the larger share of genuine capacity.

Again, there is a fallacy about Examiners. It is commonly supposed that any one who knows a subject is competent to teach it; and no one seems to doubt that any one who knows a subject is competent to examine in it. I believe both these [230] opinions to be serious mistakes: the latter, perhaps, the more serious of the two. In the first place, I do not believe that any one who is not, or has not been, a teacher is really qualified to examine advanced students. And in the second place, Examination is an Art, and a difficult one, which has to be learned like all other arts.

Beginners always set too difficult questions–partly because they are afraid of being suspected of ignorance if they set easy ones, and partly from not understanding their business. Suppose that you want

to test the relative physical strength of a score of young men. You do not put a hundredweight down before them, and tell each to swing it round. If you do, half of them won't be able to lift it at all, and only one or two will be able to perform the task. You must give them half a hundredweight, and see how they manœuver that, if you want to form any estimate of the muscular strength of each. So, a practised Examiner will seek for information respecting the mental vigour and training of candidates from the way in which they deal with questions easy enough to let reason, memory, and method have free play.

No doubt, a great deal is to be done by the careful selection of Examiners, and by the copious introduction of practical work, to remove the evils inseparable from examination; but, under the best of circumstances, I believe that examination [231] will remain but an imperfect test of knowledge, and a still more imperfect test of capacity, while it tells next to nothing about a man's power as an investigator.

There is much to be said in favour of restricting the highest degrees in each Faculty, to those who have shown evidence of such original power, by prosecuting a research under the eye of the Professor in whose province it lies; or, at any rate, under conditions which shall afford satisfactory proof that the work is theirs. The notion may sound revolutionary, but it is really very old; for, I take it, that it lies at the bottom of that presentation of a thesis by the candidate for a doctorate, which has now, too often, become little better than a matter of form.

Thus far, I have endeavoured to lay before you, in a too brief and imperfect manner, my views respecting the teaching half–the Magistri and Regentes–of the University of the Future. Now let me turn to the learning half–the Scholares.

If the Universities are to be the sanctuaries of the highest culture of the country, those who would enter that sanctuary must not come with unwashed hands. If the good seed is to yield its hundredfold harvest, it must not be scattered amidst the stones of ignorance, or the tares of undisciplined indolence and wantonness. On the [232] contrary, the soil must have been carefully prepared, and the Professor should find that the operations of clod-crushing, draining, and weeding, and even a good deal of planting, have been done by the Schoolmaster.

That is exactly what the Professor does not find in any University in the three Kingdoms that I can hear of–the reason of which state of things lies in the extremely faulty organisation of the majority of secondary schools. Students come to the Universities ill-prepared in classics and mathematics, not at all prepared in anything else; and half their time is spent in learning that which they ought to have known when they came.

I sometimes hear it said that the Scottish Universities differ from the English, in being to a much greater extent places of comparatively elementary education for a younger class of students. But it would seem doubtful if any great difference of this kind really exists; for a high authority, himself Head of an English College, has solemnly affirmed that: "Elementary teaching of youths under twenty is now the only function performed by the University;" and that Colleges are "boarding schools in which the elements of the learned languages are taught to youths."[3]

[233] This is not the first time that I have quoted those remarkable assertions. I should like to engrave them in public view, for they have not been refuted; and I am convinced that if their import is once clearly apprehended, they will play no mean part when the question of University reorganisation, with a view to practical measures, comes on for discussion. You are not responsible for this anomalous state of affairs now; but, as you pass into active life and acquire the political influence to which your education and your position should entitle you, you will become responsible for it, unless each in his sphere does his best to alter it, by insisting on the improvement of secondary schools.

Your present responsibility is of another, though not less serious, kind. Institutions do not make men, any more than organisation makes life; and even the ideal University we have been dreaming about will be but a superior piece of mechanism, unless each student strive after the ideal of the Scholar. And that ideal, it seems to me, has never been better embodied than by the great Poet, who, though lapped in luxury, the favourite of a Court, and the idol of his countrymen, remained through all the length of his honoured years a Scholar in Art, in Science, and in Life.

> "Wouldst shape a noble life? Then cast
> No backward glances towards the past:
> And though somewhat be lost and gone,
> Yet do thou act as one new-born.
> What each day needs, that shalt thou ask;
> Each day will set its proper task,
> Give others' work just share of praise;
> Not of thine own the merits raise.
> Beware no fellow man thou hate;
> And so in God's hands leave thy fate.[4]

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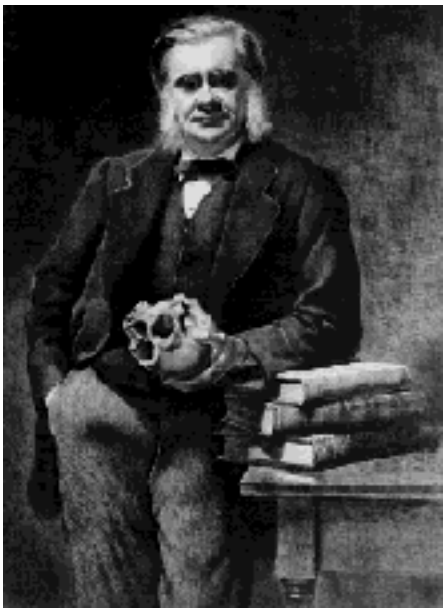
[1] "Quamvis enim melius sit bene fascere quam nosse, prius tamen est nosse quam fascere."–"Karoli Magni Regis Constitutio de Scholis per singula Episcopia et Monasteria instituendis," addressed to the Abbot of Fulda. Baluzius, *Capiotularia Regum Francorum*, T. i. p. 202.

[2] Inaugural Address delivered to the University of St. Andrew, February 1, 1867, by J. S. Mill, Rector of the University (pp. 32, 33).

[3] *Suggestions for Academical Organisation, with Especial Reference to Oxford.* By the Rector of Lincoln.

[4] Goethe, *Zahme Xenien, Vierte Abtheilung.* I should be glad to take credit for the close and vigorous English version; but it is my wife's, and not mine.

THE HUXLEY FILE



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C. Blinderman & D. Joyce
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Address on University Education [1] (1876)

Collected Essays III

[235] The actual work of the University founded in this city by the well-considered munificence of Johns Hopkins commences to-morrow, and among the many marks of confidence and good-will which have been bestowed upon me in the United States, there is none which I value more highly than that conferred by the authorities of the University when they invited me to deliver an address on such an occasion.

For the event which has brought us together is, in many respects, unique. A vast property is handed over to an administrative body, hampered [236] by no conditions save these:–That the principal shall not be employed in building: that the funds shall be appropriated, in equal proportions, to the promotion of natural knowledge and to the alleviation of the bodily sufferings of mankind; and, finally, that neither political nor ecclesiastical sectarianism shall be permitted to disturb the impartial distribution of the testator's benefactions.

In my experience of life a truth which sounds very much like a paradox has often asserted itself: namely, that a man's worst difficulties begin when he is able to do as he likes. So long as a man is struggling with obstacles he has an excuse for failure or shortcoming; but when fortune removes them all and gives him the power of doing as he thinks best, then comes the time of trial. There is but one right, and the possibilities of wrong are infinite. I doubt not that the trustees of the Johns Hopkins University felt the full force of this truth when they entered on the administration of their trust a year and a half ago; and I can but admire the activity and resolution which have enabled them, aided by the able president whom they have selected, to lay down the great outlines of their plan, and carry it thus far into execution. It is impossible to study that plan without perceiving that great care, forethought, and sagacity, have been bestowed upon it, and that it demands the most [237] respectful consideration. I have been endeavouring to ascertain how far the principles which underlie it are in accordance with those which have been established in my own mind by much and long-continued thought upon educational questions. Permit me to place before you the result of my reflections.

Under one aspect a university is a particular kind of educational institution, and the views which we may take of the proper nature of a university are corollaries from those which we hold respecting education in general. I think it must be admitted that the school should prepare for the university, and that the university should crown the edifice, the foundations of which are laid in the school. University education should not be something distinct from elementary education, but should be the natural outgrowth and development of the latter. Now I have a very clear conviction as to what elementary education ought to be; what it really may be, when properly organised; and what I think it will be, before many years have passed over our heads, in England and in America. Such education should enable an average boy of fifteen or sixteen to read and write his own language with ease and accuracy, and with a sense of literary excellence derived from the study of our classic writers: to have a general acquaintance with the history

of his own country and with the great laws of [238] social existence; to have acquired the rudiments of the physical and psychological sciences, and a fair knowledge of elementary arithmetic and geometry. He should have obtained an acquaintance with logic rather by example than by precept; while the acquirement of the elements of music and drawing should have been pleasure rather than work.

It may sound strange to many ears if I venture to maintain the proposition that a young person, educated thus far, has had a liberal, though perhaps not a full, education. But it seems to me that such training as that to which I have referred may be termed liberal, in both the senses in which that word is employed, with perfect accuracy. In the first place, it is liberal in breadth. It extends over the whole ground of things to be known and of faculties to be trained, and it gives equal importance to the two great sides of human activity–art and science. In the second place, it is liberal in the sense of being an education fitted for free men; for men to whom every career is open, and from whom their country may demand that they should be fitted to perform the duties of any career. I cannot too strongly impress upon you the fact that, with such a primary education as this, and with no more than is to be obtained by building strictly upon its lines, a man of ability may become a great writer or speaker, a statesman, a lawyer, a man of science, painter, [239] sculptor, architect, or musician. That even development of all a man's faculties, which is what properly constitutes culture, may be effected by such an education, while it opens the way for the indefinite strengthening of any special capabilities with which he may be gifted.

In a country like this, where most men have to carve out their own fortunes and devote themselves early to the practical affairs of life, comparatively few can hope to pursue their studies up to, still less beyond, the age of manhood. But it is of vital importance to the welfare of the community that those who are relieved from the need of making a livelihood, and still more, those who are stirred by the divine impulses of intellectual thirst or artistic genius, should be enabled to devote themselves to the higher service of their kind, as centres of intelligence, interpreters of Nature, or creators of new forms of beauty. And it is the function of a university to furnish such men with the means of becoming that which it is their privilege and duty to be. To this end the university need cover no ground foreign to that occupied by the elementary school. Indeed it cannot; for the elementary instruction which I have referred to embraces all the kinds of real knowledge and mental activity possible to man. The university can add no new departments of knowledge, can offer no new fields of mental activity; but what it can do is to intensify and [240] specialise the instruction in each department. Thus literature and philology, represented in the elementary school by English alone, in the university will extend over the ancient and modern languages. History, which, like charity, best begins at home, but, like charity, should not end there, will ramify into anthropology, archæology, political history, and geography, with the history of the growth of the human mind and of its products in the shape of philosophy, science, and art. And the university will present to the student libraries, museums of antiquities, collections of coins, and the like, which will efficiently subserve these studies. Instruction in the elements of social economy, a most essential, but hitherto sadly-neglected part of elementary education, will develop in the university into political economy, sociology, and law. Physical science will have its great divisions of physical geography, with geology and astronomy; physics; chemistry and biology; represented not merely by professors and their lectures, but by laboratories, in which the students, under guidance of demonstrators, will work out facts for themselves and come into that direct contact with reality which constitutes the fundamental distinction of scientific education. Mathematics will soar into its highest

regions; while the high peaks of philosophy may be scaled by those whose aptitude for abstract thought has been awakened by elementary logic. Finally, [241] schools of pictorial and plastic art, of architecture, and of music, will offer a thorough discipline in the principles and practice of art to those in whom lies nascent the rare faculty of æsthetic representation, or the still rarer powers of creative genius.

The primary school and the university are the alpha and omega of education. Whether institutions intermediate between these (so-called secondary schools) should exist, appears to me to be a question of practical convenience. If such schools are established, the important thing is that they should be true intermediaries between the primary school and the university, keeping on the wide track of general culture, and not sacrificing one branch of knowledge for another.

Such appear to me to be the broad outlines of the relations which the university, regarded as a place of education, ought to bear to the school, but a number of points of detail require some consideration, however briefly and imperfectly I can deal with them. In the first place, there is the important question of the limitations which should be fixed to the entrance into the university; or, what qualifications should be required of those who propose to take advantage of the higher training offered by the university. On the one hand, it is obviously desirable that the time and opportunities of the university should not be wasted [242] in conferring such elementary instruction as can be obtained elsewhere; while, on the other hand, it is no less desirable that the higher instruction of the university should be made accessible to every one who can take advantage of it, although he may not have been able to go through any very extended course of education. My own feeling is distinctly against any absolute and defined preliminary examination, the passing of which shall be an essential condition of admission to the university. I would admit to the university any one who could be reasonably expected to profit by the instruction offered to him; and I should be inclined, on the whole, to test the fitness of the student, not by examination before he enters the university, but at the end of his first term of study. If, on examination in the branches of knowledge to which he has devoted himself, he show himself deficient in industry or in capacity, it will be best for the university and best for himself, to prevent him from pursuing a vocation for which he is obviously unfit. And I hardly know of any other method than this by which his fitness or unfitness can be safely ascertained, though no doubt a good deal may be done, not by formal cut and dried examination, but by judicious questioning, at the outset of his career.

Another very important and difficult practical question is, whether a definite course of study shall be laid down for those who enter the [243] university; whether a curriculum shall be prescribed; or whether the student shall be allowed to range at will among the subjects which are open to him. And this question is inseparably connected with another, namely, the conferring of degrees. It is obviously impossible that any student should pass through the whole of the series of courses of instruction offered by a university. If a degree is to be conferred as a mark of proficiency in knowledge, it must be given on the ground that the candidate is proficient in a certain fraction of those studies; and then will arise the necessity of insuring an equivalency of degrees, so that the course by which a degree is obtained shall mark approximately an equal amount of labour and of acquirements, in all cases. But this equivalency can hardly be secured in any other way than by prescribing a series of definite lines of study. This is a matter which will require grave consideration. The important points to bear in mind, I think, are that there should not be too many subjects in the curriculum, and that the aim should be the attainment of thorough

and sound knowledge of each.

One half of the Johns Hopkins bequest is devoted to the establishment of a hospital, and it was the desire of the testator that the university and the hospital should co-operate in the promotion of medical education. The trustees [244] will unquestionably take the best advice that is to be had as to the construction and administration of the hospital. In respect to the former point, they will doubtless remember that a hospital may be so arranged as to kill more than it cures; and, in regard to the latter, that a hospital may spread the spirit of pauperism among the well-to-do, as well as relieve the sufferings of the destitute. It is not for me to speak on these topics–rather let me confine myself to the one matter on which my experience as a student of medicine, and an examiner of long standing, who has taken a great interest in the subject of medical education, may entitle me to a hearing. I mean the nature of medical education itself, and the co-operation of the university in its promotion.

What is the object of medical education? It is to enable the practitioner, on the one hand, to prevent disease by his knowledge of hygiene; on the other hand, to divine its nature, and to alleviate or cure it, by his knowledge of pathology, therapeutics, and practical medicine. That is his business in life, and if he has not a thorough and practical knowledge of the conditions of health, of the causes which tend to the establishment of disease, of the meaning of symptoms, and of the uses of medicines and operative appliances, he is incompetent, even if he were the best anatomist, or physiologist, or chemist, that ever [245] took a gold medal or won a prize certificate. This is one great truth respecting medical education. Another is, that all practice in medicine is based upon theory of some sort or other; and therefore, that it is desirable to have such theory in the closest possible accordance with fact. The veriest empiric who gives a drug in one case because he has seen it do good in another of apparently the same sort, acts upon the theory that similarity of superficial symptoms means similarity of lesions; which, by the way, is perhaps as wild an hypothesis as could be invented. To understand the nature of disease we must understand health, and the understanding of the healthy body means the having a knowledge of its structure and of the way in which its manifold actions are performed, which is what is technically termed human anatomy and human physiology. The physiologist again must needs possess an acquaintance with physics and chemistry, inasmuch as physiology is, to a great extent, applied physics and chemistry. For ordinary purposes a limited amount of such knowledge is all that is needful; but for the pursuit of the higher branches of physiology no knowledge of these branches of science can be too extensive, or too profound. Again, what we call therapeutics, which has to do with the action of drugs and medicines on the living organism, is, strictly speaking, a branch of experimental physiology, [246] and is daily receiving a greater and greater experimental development.

The third great fact which is to be taken into consideration in dealing with medical education, is that the practical necessities of life do not, as a rule, allow aspirants to medical practice to give more than three, or it may be four years to their studies. Let us put it at four years, and then reflect that, in the course of this time, a young man fresh from school has to acquaint himself with medicine, surgery, obstetrics, therapeutics, pathology, hygiene, as well as with the anatomy and the physiology of the human body; and that his knowledge should be of such a character that it can be relied upon in any emergency, and always ready for practical application. Consider, in addition, that the medical practitioner may be called upon, at any moment, to give evidence in a court of justice in a criminal case; and that it is therefore well

that he should know something of the laws of evidence, and of what we call medical jurisprudence. On a medical certificate, a man may be taken from his home and from his business and confined in a lunatic asylum; surely, therefore, it is desirable that the medical practitioner should have some rational and clear conceptions as to the nature and symptoms of mental disease. Bearing in mind all these requirements of medical education, you will admit that the burden on the young aspirant for the medical [247] profession is somewhat of the heaviest, and that it needs some care to prevent his intellectual back from being broken.

Those who are acquainted with the existing systems of medical education will observe that, long as is the catalogue of studies which I have enumerated, I have omitted to mention several that enter into the usual medical curriculum of the present day. I have said not a word about zoology, comparative anatomy, botany, or materia medica. Assuredly this is from no light estimate of the value or importance of such studies in themselves. It may be taken for granted that I should be the last person in the world to object to the teaching of zoology, or comparative anatomy, in themselves; but I have the strongest feeling that, considering the number and the gravity of those studies through which a medical man must pass, if he is to be competent to discharge the serious duties which devolve upon him, subjects which lie so remote as these do from his practical pursuits should be rigorously excluded. The young man, who has enough to do in order to acquire such familiarity with the structure of the human body as will enable him to perform the operations of surgery, ought not, in my judgment, to be occupied with investigations into the anatomy of crabs and starfishes. Undoubtedly the doctor should know the common poisonous plants of his own country when he sees them; but that knowledge may be obtained by a [248] few hours devoted to the examination of specimens of such plants, and the desirableness of such knowledge is no justification, to my mind, for spending three months over the study of systematic botany. Again, materia medica, so far as it is a knowledge of drugs, is the business of the druggist. In all other callings the necessity of the division of labour is fully recognised, and it is absurd to require of the medical man that he should not avail himself of the special knowledge of those whose business it is to deal in the drugs which he uses. It is all very well that the physician should know that castor oil comes from a plant, and castoreum from an animal, and how they are to be prepared; but for all the practical purposes of his profession that knowledge is not of one whit more value, has no more relevancy, than the knowledge of how the steel of his scalpel is made.

All knowledge is good. It is impossible to say that any fragment of knowledge, however insignificant or remote from one's ordinary pursuits, may not some day be turned to account. But in medical education, above all things, it is to be recollected that, in order to know a little well, one must be content to be ignorant of a great deal.

Let it not be supposed that I am proposing to narrow medical education, or, as the cry is, to lower the standard of the profession. Depend upon it there is only one way of really ennobling any calling, and that is to make those who pursue it real [249] masters of their craft, men who can truly do that which they profess to be able to do, and which they are credited with being able to do by the public. And there is no position so ignoble as that of the so-called "liberally-educated practitioner," who may be able to read Galen in the original; who knows all the plants, from the cedar of Lebanon to the hyssop upon the wall; but who finds himself, with the issues of life and death in his hands, ignorant, blundering, and

bewildered, because of his ignorance of the essential and fundamental truths upon which practice must be based. Moreover, I venture to say, that any man who has seriously studied all the essential branches of medical knowledge; who has the needful acquaintance with the elements of physical science; who has been brought by medical jurisprudence into contact with law; whose study of insanity has taken him into the fields of psychology; has *ipso facto* received a liberal education.

Having lightened the medical curriculum by culling out of it everything which is unessential, we may next consider whether something may not be done to aid the medical student toward the acquirement of real knowledge by modifying the system of examination. In England, within my recollection, it was the practice to require of the medical student attendance on lectures upon the most diverse topics during three years; so that it [250] often happened that he would have to listen, in the course of a day, to four or five lectures upon totally different subjects, in addition to the hours given to dissection and to hospital practice: and he was required to keep all the knowledge he could pick up, in this distracting fashion, at examination point, until, at the end of three years, he was set down to a table and questioned pell-mell upon all the different matters with which he had been striving to make acquaintance. A worse system and one more calculated to obstruct the acquisition of sound knowledge and to give full play to the "crammer" and the "grinder" could hardly have been devised by human ingenuity. Of late years great reforms have taken place. Examinations have been divided so as to diminish the number of subjects among which the attention has to be distributed. Practical examination has been largely introduced; but there still remains, even under the present system, too much of the old evil inseparable from the contemporaneous pursuit of a multiplicity of diverse studies.

Proposals have recently been made to get rid of general examinations altogether, to permit the student to be examined in each subject at the end of his attendance on the class; and then, in case of the result being satisfactory, to allow him to have done with it; and I may say that this method has been pursued for many years in the Royal School of Mines in London, and has been found to work [251] very well. It allows the student to concentrate his mind upon what he is about for the time being, and then to dismiss it. Those who are occupied in intellectual work, will, I think, agree with me that it is important, not so much to know a thing, as to have known it, and known it thoroughly. If you have once known a thing in this way it is easy to renew your knowledge when you have forgotten it; and when you begin to take the subject up again, it slides back upon the familiar grooves with great facility.

Lastly comes the question as to how the university may co-operate in advancing medical education. A medical school is strictly a technical school–a school in which a practical profession is taught–while a university ought to be a place in which knowledge is obtained without direct reference to professional purposes. It is clear, therefore, that a university and its antecedent, the school, may best co-operate with the medical school by making due provision for the study of those branches of knowledge which lie at the foundation of medicine.

At present, young men come to the medical schools without a conception of even the elements of physical science; they learn, for the first time, that there are such sciences as physics, chemistry, and physiology, and are introduced to anatomy as a new thing. It may be safely said that, with a large proportion of medical students, much of the [252] first session is wasted in learning how to learn–in

familiarising themselves with utterly strange conceptions, and in awakening their dormant and wholly untrained powers of observation and of manipulation. It is difficult to over-estimate the magnitude of the obstacles which are thrown in the way of scientific training by the existing system of school education. Not only are men trained in mere book-work, ignorant of what observation means, but the habit of learning from books alone begets a disgust of observation. The book-learned student will rather trust to what he sees in a book than to the witness of his own eyes.

There is not the least reason why this should be so, and, in fact, when elementary education becomes that which I have assumed it ought to be, this state of things will no longer exist. There is not the slightest difficulty in giving sound elementary instruction in physics, in chemistry, and in the elements of human physiology, in ordinary schools. In other words, there is no reason why the student should not come to the medical school, provided with as much knowledge of these several sciences as he ordinarily picks up in the course of his first year of attendance at the medical school.

I am not saying this without full practical justification for the statement. For the last eighteen years we have had in England a system [253] of elementary science teaching carried out under the auspices of the Science and Art Department, by which elementary scientific instruction is made readily accessible to the scholars of all the elementary schools in the country. Commencing with small beginnings, carefully developed and improved, that system now brings up for examination as many as seven thousand scholars in the subject of human physiology alone. I can say that, out of that number, a large proportion have acquired a fair amount of substantial knowledge; and that no inconsiderable percentage show as good an acquaintance with human physiology as used to be exhibited by the average candidates for medical degrees in the University of London, when I was first an examiner there twenty years ago; and quite as much knowledge as is possessed by the ordinary student of medicine at the present day. I am justified, therefore, in looking forward to the time when the student who proposes to devote himself to medicine will come, not absolutely raw and inexperienced as he is at present, but in a certain state of preparation for further study; and I look to the university to help him still further forward in that stage of preparation, through the organisation of its biological department. Here the student will find means of acquainting himself with the phenomena of life in their broadest acceptation. He will study not botany and zoology, which, as I have said, would [254] take him too far away from his ultimate goal; but, by duly arranged instruction, combined with work in the laboratory upon the leading types of animal and vegetable life, he will lay a broad, and at the same time solid, foundation of biological knowledge; he will come to his medical studies with a comprehension of the great truths of morphology and of physiology, with his hands trained to dissect and his eyes taught to see. I have no hesitation in saying that such preparation is worth a full year added on to the medical curriculum. In other words, it will set free that much time for attention to those studies which bear directly upon the student's most grave and serious duties as a medical practitioner.

Up to this point I have considered only the teaching aspect of your great foundation, that function of the university in virtue of which it plays the part of a reservoir of ascertained truth, so far as our symbols can ever interpret nature. All can learn; all can drink of this lake. It is given to few to add to the store of knowledge, to strike new springs of thought, or to shape new forms of beauty. But so sure as it is that men live not by bread, but by ideas, so sure is it that the future of the world lies in the hands of those

who are able to carry the interpretation of nature a step further than their predecessors; so certain is it that the highest function of a university is to seek out those men, cherish them, [255] and give their ability to serve their kind full play.

I rejoice to observe that the encouragement of research occupies so prominent a place in your official documents, and in the wise and liberal inaugural address of your president. This subject of the encouragement, or, as it is sometimes called, the endowment of research, has of late years greatly exercised the minds of men in England. It was one of the main topics of discussion by the members of the Royal Commission of whom I was one, and who not long since issued their report, after five years' labour. Many seem to think that this question is mainly one of money; that you can go into the market and buy research, and that supply will follow demand, as in the ordinary course of commerce. This view does not commend itself to my mind. I know of no more difficult practical problem than the discovery of a method of encouraging and supporting the original investigator without opening the door to nepotism and jobbery. My own conviction is admirably summed up in the passage of your president's address, "that the best investigators are usually those who have also the responsibilities of instruction, gaining thus the incitement of colleagues, the encouragement of pupils, and the observation of the public."

At the commencement of this address I ventured to assume that I might, if I thought fit, criticise [256] the arrangements which have been made by the board of trustees, but I confess that I have little to do but to applaud them. Most wise and sagacious seems to me the determination not to build for the present. It has been my fate to see great educational funds fossilise into mere bricks and mortar, in the petrifying springs of architecture, with nothing left to work the institution they were intended to support. A great warrior is said to have made a desert and called it peace. Administrators of educational funds have sometimes made a palace and called it a university. If I may venture to give advice in a matter which lies out of my proper competency, I would say that whenever you do build, get an honest bricklayer, and make him build you just such rooms as you really want, leaving ample space for expansion. And a century hence, when the Baltimore and Ohio shares are at one thousand premium, and you have endowed all the professors you need, and built all the laboratories that are wanted, and have the best museum and the finest library that can be imagined; then, if you have a few hundred thousand dollars you don't know what to do with, send for an architect and tell him to put up a façade. If American is similar to English experience, any other course will probably lead you into having some stately structure, good for your architect's fame, but not in the least what you want.

[257] It appears to me that what I have ventured to lay down as the principles which should govern the relations of a university to education in general, are entirely in accordance with the measures you have adopted. You have set no restrictions upon access to the instruction you propose to give; you have provided that such instruction, either as given by the university or by associated institutions, should cover the field of human intellectual activity. You have recognised the importance of encouraging research. You propose to provide means by which young men, who may be full of zeal for a literary or for a scientific career, but who also may have mistaken aspiration for inspiration, may bring their capacities to a test, and give their powers a fair trial. If such a one fail, his endowment terminates, and there is no harm done. If he succeed, you may give power of flight to the genius of a Davy or a Faraday, a Carlyle or a Locke, whose influence on the future of his fellowmen shall be absolutely incalculable.

You have enunciated the principles that "the glory of the university should rest upon the character of the teachers and scholars, and not upon their numbers or buildings constructed for their use." And I look upon it as an essential and most important feature of your plan that the income of the professors and teachers shall be independent of the number of students whom [258] they can attract. In this way you provide against the danger, patent elsewhere, of finding attempts at improvement obstructed by vested interests; and, in the department of medical education especially, you are free of the temptation to set loose upon the world men utterly incompetent to perform the serious and responsible duties of their profession.

It is a delicate matter for a stranger to the practical working of your institutions, like myself, to pretend to give an opinion as to the organisation of your governing power. I can conceive nothing better than that it should remain as it is, if you can secure a succession of wise, liberal, honest, and conscientious men to fill the vacancies that occur among you. I do not greatly believe in the efficacy of any kind of machinery for securing such a result; but I would venture to suggest that the exclusive adoption of the method of co-optation for filling the vacancies which must occur in your body, appears to me to be somewhat like a tempting of Providence. Doubtless there are grave practical objections to the appointment of persons outside of your body and not directly interested in the welfare of the university; but might it not be well if there were an understanding that your academic staff should be officially represented on the board, perhaps even the heads of one or two independent learned bodies, so that academic opinion and the views of the outside world might [259] have a certain influence in that most important matter, the appointment of your professors I throw out these suggestions, as I have said, in ignorance of the practical difficulties that may lie in the way of carrying them into effect, on the general ground that personal and local influences are very subtle, and often unconscious, while the future greatness and efficiency of the noble institution which now commences its work must largely depend upon its freedom from them.

I constantly hear Americans speak of the charm which our old mother country has for them, of the delight with which they wander through the streets of ancient towns, or climb the battlements of mediæval strongholds, the names of which are indissolubly associated with the great epochs of that noble literature which is our common inheritance; or with the blood-stained steps of that secular progress, by which the descendants of the savage Britons and of the wild pirates of the North Sea have become converted into warriors of order and champions of peaceful freedom, exhausting what still remains of the old Berserk spirit in subduing nature, and turning the wilderness into a garden. But anticipation has no less charm than retrospect, and to an Englishman landing upon your shores for the first time, travelling for hundreds of miles through strings of great and well-ordered cities, seeing your enormous actual, and almost infinite [260] potential, wealth in all commodities, and in the energy and ability which turn wealth to account, there is something sublime in the vista of the future. Do not suppose that I am pandering to what is commonly understood by national pride. I cannot say that I am in the slightest degree impressed by your bigness, or your material resources, as such. Size is not grandeur, and territory does not make a nation. The great issue, about which hangs a true sublimity, and the terror of overhanging fate, is what are you going to do with all these things? What is to be the end to which these are to be the means? You are making a novel experiment in politics on the greatest scale which the

world has yet seen. Forty millions at your first centenary, it is reasonably to be expected that, at the second, these states will be occupied by two hundred millions of English-speaking people, spread over an area as large as that of Europe, and with climates and interests as diverse as those of Spain and Scandinavia, England and Russia. You and your descendants have to ascertain whether this great mass will hold together under the forms of a republic, and the despotic reality of universal suffrage; whether state rights will hold out against centralisation, without separation; whether centralisation will get the better, without actual or disguised monarchy; whether shifting corruption is better than a permanent bureaucracy; and as population thickens in your [261] great cities, and the pressure of want is felt, the gaunt spectre of pauperism will stalk among you, and communism and socialism will claim to be heard. Truly America has a great future before her; great in toil, in care, and in responsibility; great in true glory if she be guided in wisdom and righteousness; great in shame if she fail. I cannot understand why other nations should envy you, or be blind to the fact that it is for the highest interest of mankind that you should succeed; but the one condition of success, your sole safeguard, is the moral worth and intellectual clearness of the individual citizen. Education cannot give these, but it may cherish them and bring them to the front in whatever station of society they are to be found; and the universities ought to be, and may be, the fortresses of the higher life of the nation.

May the university which commences its practical activity to-morrow abundantly fulfil its high purpose; may its renown as a seat of true learning, a centre of free inquiry, a focus of intellectual light, increase year by year, until men wander hither from all parts of the earth, as of old they sought Bologna, or Paris, or Oxford.

And it is pleasant to me to fancy that, among the English students who are drawn to you at that time, there may linger a dim tradition that a countryman of theirs was permitted to address you as he has done to-day, and to feel as if your hopes were his hopes and your success his joy.

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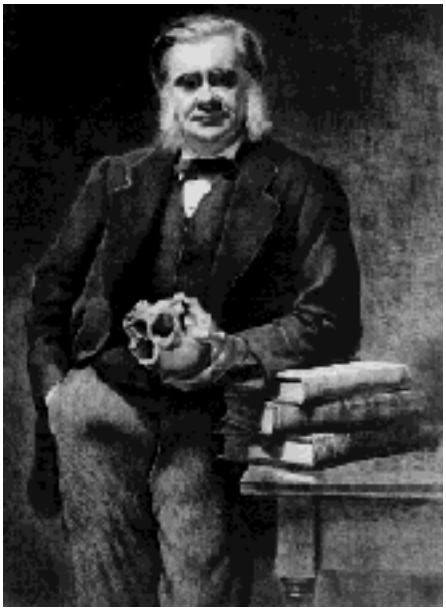
[1] Delivered at the formal opening of the Johns Hopkins University at Baltimore, U.S., September 12. The total amount bequeathed by Johns Hopkins is more than 7,000,000 dollars. The sum of 3,500,000 dollars is appropriated to a university, a like sum to a hospital, and the rest to local institutions of education and charity.

THE HUXLEY FILE



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C. Blinderman & D. Joyce
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On the Study of Biology (1876)

Collected Essays III

[262] It is my duty to-night to speak about the study of Biology, and while it may be that there are many of my audience who are quite familiar with that study, yet as a lecturer of some standing, it would, I know by experience, be very bad policy on my part to suppose such to be extensively the case. On the contrary, I must imagine that there are many of you who would like to know what Biology is; that there are others who have that amount of information, but would nevertheless gladly hear why it should be worth their while to study Biology; and yet others, again, to whom these two points are clear, but who desire to learn how they had best study it, and, finally, when they had best study it.

I shall, therefore, address myself to the endeavour [263] to give you some answer to these four questions–what Biology is; why it should be studied; how it should be studied; and when it should be studied.

In the first place, in respect to what Biology is, there are, I believe, some persons who imagine that the term "Biology" is simply a new-fangled denomination, a neologism in short, for what used to be known under the title of "Natural History;" but I shall try to show you, on the contrary, that the word is the expression of the growth of science during the last 200 years, and came into existence half a century ago.

At the revival of learning, knowledge was divided into two kinds–the knowledge of nature and the knowledge of man; for it was the current idea then (and a great deal of that ancient conception still remains) that there was a sort of essential antithesis, not to say antagonism, between nature and man; and that the two had not very much to do with one another, except that the one was oftentimes exceedingly troublesome to the other. Though it is one of the salient merits of our great philosophers of the seventeenth century, that they recognised but one scientific method, applicable alike to man and to nature, we find this notion of the existence of a broad distinction between nature and man in the writings both of Bacon and of Hobbes of Malmesbury; and I have brought with me that famous work which [264] is now so little known, greatly as it deserves to be studied, "The Leviathan," in order that I may put to you in the wonderfully terse and clear language of Thomas Hobbes, what was his view of the matter. He says:–

"The register of knowledge of fact is called history. Whereof there be two sorts, one called natural history; which is the history of such facts or effects of nature as have no dependence on man's will; such as are the histories of metals, plants, animals, regions, and the like. The other is civil history; which is the history of the voluntary actions of men in commonwealths."

So that all history of fact was divided into these two great groups of natural and of civil history. The Royal Society was in course of foundation about the time that Hobbes was writing this book, which was published in 1651; and that Society was termed a "Society for the Improvement of Natural Knowledge,"

which was then nearly the same thing as a "Society for the Improvement of Natural History." As time went on, and the various branches of human knowledge became more distinctly developed and separated from one another, it was found that some were much more susceptible of precise mathematical treatment than others. The publication of the "Principia" of Newton, which probably gave a greater stimulus to physical science than any work ever published before, or which is likely to be [265] published hereafter, showed that precise mathematical methods were applicable to those branches of science such as astronomy, and what we now call physics, which occupy a very large portion of the domain of what the older writers understood by natural history. And inasmuch as the partly deductive and partly experimental methods of treatment to which Newton and others subjected these branches of human knowledge, showed that the phenomena of nature which belonged to them were susceptible of explanation, and thereby came within the reach of what was called "philosophy" in those days; so much of this kind of knowledge as was not included under astronomy came to be spoken of as "natural philosophy"–a term which Bacon had employed in a much wider sense. Time went on, and yet other branches of science developed themselves. Chemistry took a definite shape; and since all these sciences, such as astronomy, natural philosophy, and chemistry, were susceptible either of mathematical treatment or of experimental treatment, or of both, a broad distinction was drawn between the experimental branches of what had previously been called natural history and the observational branches–those in which experiment was (or appeared to be) of doubtful use, and where, at that time, mathematical methods were inapplicable. Under these circumstances the old name of "Natural History" stuck by the residuum, by [266] those phenomena which were not, at that time, susceptible of mathematical or experimental treatment; that is to say, those phenomena of nature which come now under the general heads of physical geography, geology, mineralogy, the history of plants, and the history of animals. It was in this sense that the term was understood by the great writers of the middle of the last century–Buffon and Linnæus–by Buffon in his great work, the "Histoire Naturelle Générale," and by Linnæus in his splendid achievement, the "Systema Naturæ." The subjects they deal with are spoken of as "Natural History," and they called themselves and were called "Naturalists." But you will observe that this was not the original meaning of these terms; but that they had, by this time, acquired a signification widely different from that which they possessed primitively.

The sense in which "Natural History" was used at the time I am now speaking of has, to a certain extent, endured to the present day. There are now in existence in some of our northern universities, chairs of "Civil and Natural History," in which "Natural History" is used to indicate exactly what Hobbes and Bacon meant by that term. The unhappy incumbent of the chair of Natural History is, or was, supposed to cover the whole ground of geology, mineralogy, and zoology, perhaps even botany, in his lectures.

But as science made the marvellous progress [267] which it did make at the latter end of the last and the beginning of the present century, thinking men began to discern that under this title of "Natural History" there were included very heterogeneous constituents–that, for example, geology and mineralogy were, in many respects, widely different from botany and zoology; that a man might obtain an extensive knowledge of the structure and functions of plants and animals, without having need to enter upon the study of geology or mineralogy, and *vice versâ;* and, further as knowledge advanced, it became clear that there was a great analogy, a very close alliance, between those two sciences, of botany and zoology which deal with human beings, while they are much more widely separated from all other studies. It is

due to Buffon to remark that he clearly recognised this great fact. He says: "Ces deux genres d'êtres organisés [les animaux et les végétaux] ont beaucoup plus de propriétés communes que de différences réelles." Therefore, it is not wonderful that, at the beginning of the present century, in two different countries, and so far as I know, without any intercommunication, two famous men clearly conceived the notion of uniting the sciences which deal with living matter into one whole, and of dealing with them as one discipline. In fact, I may say there were three men to whom this idea occurred contemporaneously, although there were but two who carried it into effect, and only one [268] who worked it out completely. The persons to whom I refer were the eminent physiologist Bichat, and the great naturalist Lamarck, in France; and a distinguished German, Treviranus. Bichat[1] assumed the existence of a special group of "physiological" sciences. Lamarck, in a work published in 1801,[2] for the first time made use of the name "Biologie," from the two Greek words which signify a discourse upon life and living things. About the same time, it occurred to Treviranus, that all those sciences which deal with living matter are essentially and fundamentally one, and ought to be treated as a whole; and, in the year 1802, he published the first volume of what he also called "Biologie." Treviranus's great merit lies in this, that he worked out his idea, and wrote the very remarkable book to which I refer. It consists of six volumes, and occupied its author for twenty years–from 1802 to 1822.

That is the origin of the term "Biology"; and that is how it has come about that all clear thinkers and lovers of consistent nomenclature have substituted for the old confusing name of "Natural History," which has conveyed so many meanings, the term "Biology" which denotes the whole of the sciences which deal with living [269] things, whether they be animals or whether they be plants. Some little time ago–in the course of this year, I think–I was favoured by a learned classic, Dr. Field of Norwich, with a disquisition in which he endeavoured to prove that, from a philological point of view, neither Treviranus nor Lamarck had any right to coin this new word "Biology" for their purpose; that, in fact, the Greek word "Bios" had relation only to human life and human affairs, and that a different word was employed by the Greeks when they wished to speak of the life of animals and plants. So Dr. Field tells us we are all wrong in using the term biology, and that we ought to employ another; only he is not sure about the propriety of that which he proposes as a substitute. It is a somewhat hard one–"zootocology." I am sorry we are wrong, because we are likely to continue so. In these matters we must have some sort of "Statute of Limitations." When a name has been employed for half a century, persons of authority[3] have been using it, and its sense has become well understood, I am afraid people will go on using it, whatever the weight of philological objection.

Now that we have arrived at the origin of this word "Biology," the next point to consider is: [270] What ground does it cover? I have said that in its strict technical sense, it denotes all the phenomena which are exhibited by living things, as distinguished from those which are not living; but while that is all very well, so long as we confine ourselves to the lower animals and to plants, it lands us in considerable difficulties when we reach the higher forms of living things. For whatever view we may entertain about the nature of man, one thing is perfectly certain, that he is a living creature. Hence, if our definition is to be interpreted strictly, we must include man and all his ways and works under the head of Biology; in which case, we should find that psychology, politics, and political economy would be absorbed into the province of Biology. In fact, civil history would be merged in natural history. In strict logic it may be

hard to object to this course, because no one can doubt that the rudiments and outlines of our own mental phenomena are traceable among the lower animals. They have their economy and their polity, and if, as is always admitted, the polity of bees and the commonwealth of wolves fall within the purview of the biologist proper, it becomes hard to say why we should not include therein human affairs, which, in so many cases, resemble those of the bees in zealous getting, and are not without a certain parity in the proceedings of the wolves. The real fact is that we biologists are a self-sacrificing people; [271] and inasmuch as, on a moderate estimate, there are about a quarter of a million different species of animals and plants to know about already, we feel that we have more than sufficient territory. There has been a sort of practical convention by which we give up to a different branch of science what Bacon and Hobbes would have called "Civil History." That branch of science has constituted itself under the head of Sociology. I may use phraseology which, at present, will be well understood and say that we have allowed that province of Biology to become autonomous; but I should like you to recollect that that is a sacrifice, and that you should not be surprised if it occasionally happens that you see a biologist apparently trespassing in the region of philosophy or politics; or meddling with human education; because, after all, that is a part of his kingdom which he has only voluntarily forsaken.

Having now defined the meaning of the word Biology, and having indicated the general scope of Biological Science, I turn to my second question, which is–Why should we study Biology? Possibly the time may come when that will seem a very odd question. That we, living creatures, should not feel a certain amount of interest in what it is that constitutes our life will eventually, under altered ideas of the fittest objects of human inquiry, appear to be a singular phenomenon; but at present, judging by the practice of teachers and [272] educators, Biology would seem to be a topic that does not concern us at all. I propose to put before you a few considerations with which I dare say many will be familiar already, but which will suffice to show–not fully, because to demonstrate this point fully would take a great many lectures–that there are some very good and substantial reasons why it may be advisable that we should know something about this branch of human learning.

I myself entirely agree with another sentiment of the philosopher of Malmesbury, "that the scope of all speculation is the performance of some action or thing to be done," and I have not any very great respect for, or interest in, mere knowing as such. I judge of the value of human pursuits by their bearing upon human interests; in other words, by their utility; but I should like that we should quite clearly understand what it is that we mean by this word "utility." In an Englishman's mouth it generally means that by which we get pudding or praise, or both. I have no doubt that is one meaning of the word utility, but it by no means includes all I mean by utility. I think that knowledge of every kind is useful in proportion as it tends to give people right ideas, which are essential to the foundation of right practice, and to remove wrong ideas, which are the no less essential foundations and fertile mothers of every description of error in practice. And inasmuch as, [273] whatever practical people may say, this world is, after all, absolutely governed by ideas, and very often by the wildest and most hypothetical ideas. it is a matter of the very greatest importance that our theories of things, and even of things that seem a long way apart from our daily lives, should be as far as possible true, and as far as possible removed from error. It is not only in the coarser, practical sense of the word "utility," but in this higher and broader sense, that I measure the value of the study of biology by its utility; and I shall try to point out to you that you will feel the need of some knowledge of biology at a great many turns of this present nineteenth century life

of ours. For example, most of us attach great importance to the conception which we entertain of the position of man in this universe and his relation to the rest of nature. We have almost all been told, and most of us hold by the tradition, that man occupies an isolated and peculiar position in nature; that though he is in the world he is not of the world; that his relations to things about him are of a remote character; that his origin is recent, his duration likely to be short, and that he is the great central figure round which other things in this world revolve. But this is not what the biologist tells us.

At the present moment you will be kind enough to separate me from them, because it is in no way essential to my present argument that I [274] should advocate their views. Don't suppose that I am saying this for the purpose of escaping the responsibility of their beliefs; indeed, at other times and in other places, I do not think that point has been left doubtful; but I want clearly to point out to you that for my present argument they may all be wrong; and, nevertheless, my argument will hold good. The biologists tell us that all this is an entire mistake. They turn to the physical organisation of man. They examine his whole structure, his bony frame and all that clothes it. They resolve him into the finest particles into which the microscope will enable them to break him up. They consider the performance of his various functions and activities, and they look at the manner in which he occurs on the surface of the world. Then they turn to other animals, and taking the first handy domestic animal–say a dog–they profess to be able to demonstrate that the analysis of the dog leads them, in gross, to precisely the same results as the analysis of the man; that they find almost identically the same bones, having the same relations; that they can name the muscles of the dog by the names of the muscles of the man, and the nerves of the dog by those of the nerves of the man, and that, such structures and organs of sense as we find in the man such also we find in the dog; they analyse the brain and spinal cord and they find that the nomenclature which fits, [275] the one answers for the other. They carry their microscopic inquiries in the case of the dog as far as they can, and they find that his body is resolvable into the same elements as those of the man. Moreover, they trace back the dog's and the man's development, and they find that, at a certain stage of their existence, the two creatures are not distinguishable the one from the other; they find that the dog and his kind have a certain distribution over the surface of the world, comparable in its way to the distribution of the human species. What is true of the dog they tell us is true of all the higher animals; and they assert that they can lay down a common plan for the whole of these creatures, and regard the man and the dog, the horse and the ox as minor modifications of one great fundamental unity. Moreover, the investigations of the last three-quarters of a century have proved, they tell us, that similar inquiries, carried out through all the different kinds of animals which are met with in nature, will lead us, not in one straight series, but by many roads, step by step, gradation by gradation, from man, at the summit, to specks of animated jelly at the bottom of the series. So that the idea of Leibnitz, and of Bonnet, that animals form a great scale of being, in which there are a series of gradations from the most complicated form to the lowest and simplest; that idea, though not exactly in the form in which it was propounded by those philo[276]sophers, turns out to be substantially correct. More than this, when biologists pursue their investigations into the vegetable world, they find that they can, in the same way, follow out the structure of the plant, from the most gigantic and complicated trees down through a similar series of gradations, until they arrive at specks of animated jelly, which they are puzzled to distinguish from those specks which they reached by the animal road.

Thus, biologists have arrived at the conclusion that a fundamental uniformity of structure pervades the

animal and vegetable worlds, and that plants and animals differ from one another simply as diverse modifications of the same great general plan.

Again, they tell us the same story in regard to the study of function. They admit the large and important interval which, at the present time, separates the manifestations of the mental faculties observable in the higher forms of mankind, and even in the lower forms, such as we know them, from those exhibited by other animals; but, at the same time, they tell us that the foundations, or rudiments, of almost all the faculties of man are to be met with in the lower animals; that there is a unity of mental faculty as well as of bodily structure, and that, here also, the difference is a difference of degree and not of kind. I said "almost all," for a reason. Among the many distinctions which have been drawn between the [277] lower creatures and ourselves, there is one which is hardly ever insisted on,[4] but which may be very fitly spoken of in a place so largely devoted to Art as that in which we are assembled. It is this, that while, among various kinds of animals, it is possible to discover traces of all the other faculties of man, especially the faculty of mimicry, yet that particular form of mimicry which shows itself in the imitation of form, either by modelling or by drawing, is not to be met with. As far as I know, there is no sculpture or modelling, and decidedly no painting or drawing, of animal origin. I mention the fact, in order that such comfort may be derived therefrom as artists may feel inclined to take.

If what the biologists tell us is true, it will be needful to get rid of our erroneous conceptions of man, and of his place in nature, and to substitute right ones for them. But it is impossible to form any judgment as to whether the biologists are right or wrong, unless we are able to appreciate the nature of the arguments which they have to offer.

One would almost think this to be a self-evident proposition. I wonder what a scholar would say to the man who should undertake to criticise a difficult passage in a Greek play, but who obviously had not acquainted himself with [278] the rudiments of Greek grammar. And yet, before giving positive opinions about these high questions of Biology, people not only do not seem to think it necessary to be acquainted with the grammar of the subject, but they have not even mastered the alphabet. You find criticism and denunciation showered about by persons who not only have not attempted to go through the discipline necessary to enable them to be judges, but who have not even reached that stage of emergence from ignorance in which the knowledge that such a discipline is necessary dawns upon the mind. I have had to watch with some attention–in fact I have been favoured with a good deal of it myself–the sort of criticism with which biologists and biological teachings are visited. I am told every now and then that there is a "brilliant article"[5] in so-and-so, in which we are all demolished. I used to read these things once, but I am getting old now, and I have ceased to attend very much to this cry of "wolf." When one does read any of these productions, what one finds generally, on the face of it is, that the brilliant critic is devoid of even the elements of biological knowledge, and that his brilliancy is like [279] the light given out by the crackling of thorns under a pot of which Solomon speaks. So far as I recollect, Solomon makes use of the image for purposes of comparison; but I will not proceed further into that matter.

Two things must be obvious: in the first place, that every man who has the interests of truth at heart must

earnestly desire that every well-founded and just criticism that can be made should be made; but that, in the second place, it is essential to anybody's being able to benefit by criticism, that the critic should know what he is talking about, and be in a position to form a mental image of the facts symbolised by the words he uses. If not, it is as obvious in the case of a biological argument, as it is in that of a historical or philological discussion, that such criticism is a mere waste of time on the part of its author, and wholly undeserving of attention on the part of those who are criticised. Take it then as an illustration of the importance of biological study, that thereby alone are men able to form something like a rational conception of what constitutes valuable criticism of the teachings of biologists.[6]

[280] Next, I may mention another bearing of biological knowledge–a more practical one in the ordinary sense of the word. Consider the theory of infectious disease. Surely that is of interest to all of us. Now the theory of infectious disease is rapidly being elucidated by biological study. It is possible to produce, from among the lower animals, examples of devastating diseases which spread in the same manner as our infectious disorders, and which are certainly and unmistakably caused by living organisms. This fact renders it possible, at any rate, that that doctrine of the causation of infectious disease which is known under the name of "the germ theory" may be well-founded; and, if so, it must needs lead to the most important practical measures in dealing with those terrible visitations. It may be well that the general, as well as the professional, public should have a sufficient knowledge of biological truths to be able [281] to take a rational interest in the discussion of such problems, and to see, what I think they may hope to see, that, to those who possess a sufficient elementary knowledge of Biology, they are not all quite open questions.

Let me mention another important practical illustration of the value of biological study. Within the last forty years the theory of agriculture has been revolutionised. The researches of Liebig, and those of our own Lawes and Gilbert, have had a bearing upon that branch of industry the importance of which cannot be over-estimated; but the whole of these new views have grown out of the better explanation of certain processes which go on in plants; and which, of course, form a part of the subject-matter of Biology.

I might go on multiplying these examples, but I see that the clock won't wait for me, and I must therefore pass to the third question to which I referred:–Granted that Biology is something worth studying, what is the best way of studying it? Here I must point out that, since Biology is a physical science, the method of studying it must needs be analogous to that which is followed in the other physical sciences. It has now long been recognised that, if a man wishes to be a chemist, it is not only necessary that he should read chemical books and attend chemical lectures, but that he should actually perform the fundamental experiments in the laboratory for himself, and thus learn [282] exactly what the words which he finds in his books and hears from his teachers, mean. If he does not do so, he may read till the crack of doom, but he will never know much about chemistry. That is what every chemist will tell you, and the physicist will do the same for his branch of science. The great changes and improvements in physical and chemical scientific education, which have taken place of late, have all resulted from the combination of practical teaching with the reading of books and with the hearing of lectures. The same thing is true in Biology. Nobody will ever know anything about Biology except in a dilettante "paper-philosopher" way, who contents himself with reading books on botany, zoology, and

the like; and the reason of this is simple and easy to understand. It is that all language is merely symbolical of the things of which it treats; the more complicated the things, the more bare is the symbol, and the more its verbal definition requires to be supplemented by the information derived directly from the handling, and the seeing, and the touching of the thing symbolised:–that is really what is at the bottom of the whole matter. It is plain common sense, as all truth, in the long run, is only common sense clarified. If you want a man to be a tea merchant, you don't tell him to read books about China or about tea, but you put him into a tea-merchant's office where he has the handling, the smelling, and the tasting of tea. Without the [283] sort of knowledge which can be gained only in this practical way, his exploits as a tea merchant will soon come to a bankrupt termination. The "paper-philosophers" are under the delusion that physical science can be mastered as literary accomplishments are acquired, but unfortunately it is not so. You may read any quantity of books, and you may be almost as ignorant as you were at starting, if you don't have, at the back of your minds, the change for words in definite images which can only be acquired through the operation of your observing faculties on the phenomena of nature.

It may be said:–"That is all very well, but you told us just now that there are probably something like a quarter of a million different kinds of living and extinct animals and plants, and a human life could not suffice for the examination of one-fiftieth part of all these." That is true, but then comes the great convenience of the way things are arranged; which is, that although there are these immense numbers of different kinds of living things in existence, yet they are built up, after all, upon marvellously few plans.

There are certainly more than 100,000 species of insects, and yet anybody who knows one insect–if a properly chosen one–will be able to have a very fair conception of the structure of the whole. I do not mean to say he will know that structure thoroughly, or as well as it is desir[284]able he should know it; but he will have enough real knowledge to enable him to understand what he reads, to have genuine images in his mind of those structures which become so variously modified in all the forms of insects he has not seen. In fact, there are such things as types of form among animals and vegetables, and for the purpose of getting a definite knowledge of what constitutes the leading modifications of animal and plant life, it is not needful to examine more than a comparatively small number of animals and plants.

Let me tell you what we do in the biological laboratory which is lodged in a building adjacent to this. There I lecture to a class of students daily for about four-and-a-half months, and my class have of course, their text-books; but the essential part of the whole teaching, and that which I regard as really the most important part of it, is a laboratory for practical work, which is simply a room with all the appliances needed for ordinary dissection. We have tables properly arranged in regard to light, microscopes, and dissecting instruments, and we work through the structure of a certain number of animals and plants. As, for example, among the plants, we take a yeast plant, a *Protococcus*, a common mould, a *Chara*, a fern, and some flowering plant; among animals we examine such things as an *Amœba*, a *Vorticella*, and a fresh-water polype. We dissect a star-fish, an [285] earth-worm, a snail, a squid, and a fresh-water mussel. We examine a lobster and a cray-fish, and a black beetle. We go on to a common skate, a cod-fish, a frog, a tortoise, a pigeon, and a rabbit, and that takes us about all the time we have to give. The purpose of this course is not to make skilled dissectors, but to give every student a clear and definite conception, by means of sense-images, of the characteristic structure of each of the leading

modifications of the animal kingdom; and that is perfectly possible, by going no further than the length of that list of forms which I have enumerated. If a man knows the structure of the animals I have mentioned, he has a clear and exact, however limited, apprehension of the essential features of the organisation of all those great divisions of the animal and vegetable kingdoms to which the forms I have mentioned severally belong. And it then becomes possible for him to read with profit; because every time he meets with the name of a structure, he has a definite image in his mind of what the name means in the particular creature he is reading about, and therefore the reading is not mere reading. It is not mere repetition of words; but every term employed in the description, we will say, of a horse, or of an elephant, will call up the image of the things he had seen in the rabbit, and he is able to form a distinct conception of that which he has not seen, as a modification of that which he has seen.

[286] I find this system to yield excellent results; and I have no hesitation whatever in saying, that any one who has gone through such a course, attentively, is in a better position to form a conception of the great truths of Biology, especially of morphology (which is what we chiefly deal with), than if he had merely read all the books on that topic put together.

The connection of this discourse with the Loan Collection of Scientific Apparatus arises out of the exhibition in that collection of certain aids to our laboratory work. Such of you as have visited that very interesting collection may have noticed a series of diagrams and of preparations illustrating the structure of a frog. Those diagrams and preparations have been made for the use of the students in the biological laboratory. Similar diagrams and preparations illustrating the structure of all the other forms of life we examine, are either made or in course of preparation. Thus the student has before him, first, a picture of the structure he ought to see; secondly, the structure itself worked out; and if with these aids, and such needful explanations and practical hints as a demonstrator can supply, he cannot make out the facts for himself in the materials supplied to him, he had better take to some other pursuit than that of biological science.

I should have been glad to have said a few words about the use of museums in the study of [287] Biology, but I see that my time is becoming short, and I have yet another question to answer. Nevertheless, I must, at the risk of wearying you, say a word or two upon the important subject of museums. Without doubt there are no helps to the study of Biology, or rather to some branches of it, which are, or may be, more important than natural history museums; but, in order to take this place in regard to Biology, they must be museums of the future. The museums of the present do not, by any means, do so much for us as they might do. I do not wish to particularise, but I dare say many of you, seeking knowledge, or in the laudable desire to employ a holiday usefully, have visited some great natural history museum. You have walked through a quarter of a mile of animals, more or less well stuffed, with their long names written out underneath them; and, unless your experience is very different from that of most people, the upshot of it all is that you leave that splendid pile with sore feet, a bad headache, and a general idea that the animal kingdom is a "mighty maze without a plan." I do not think that a museum which brings about this result does all that may be reasonably expected from such an institution. What is needed in a collection of natural history is that it should be made as accessible and as useful as possible, on the one hand to the general public and on the other to scientific workers. [288] That need is not met by constructing a sort of happy hunting-ground of miles of glass cases; and, under

the pretence of exhibiting everything putting the maximum amount of obstacle in the way of those who wish properly to see anything.

What the public want is easy and unhindered access to such a collection as they can understand and appreciate; and what the men of science want is similar access to the materials of science. To this end the vast mass of objects of natural history should be divided into two parts–one open to the public, the other to men of science, every day. The former division should exemplify all the more important and interesting forms of life. Explanatory tablets should be attached to them, and catalogues containing clearly-written popular expositions of the general significance of the objects exhibited should be provided. The latter should contain, packed into a comparatively small space, in rooms adapted for working purposes, the objects of purely scientific interest. For example, we will say I am an ornithologist. I go to examine a collection of birds. It is a positive nuisance to have them stuffed. It is not only sheer waste, but I have to reckon with the ideas of the bird-stuffer, while, if I have the skin and nobody has interfered with it, I can form my own judgment as to what the bird was like. For ornithological purposes, what is needed is not glass cases full of stuffed birds on perches, but [289] convenient drawers into each of which a great quantity of skins will go. They occupy no great space and do not require any expenditure beyond their original cost. But for the edification of the public, who want to learn indeed, but do not seek for minute and technical knowledge, the case is different. What one of the general public walking into a collection of birds desires to see is not all the birds that can be got together. He does not want to compare a hundred species of the sparrow tribe side by side; but he wishes to know what a bird is, and what are the great modifications of bird structure, and to be able to get at that knowledge easily. What will best serve his purpose is a comparatively small number of birds carefully selected, and artistically, as well as accurately, set up; with their different ages, their nests, their young, their eggs, and their skeletons side by side; and in accordance with the admirable plan which is pursued in this museum, a tablet, telling the spectator in legible characters what they are and what they mean. For the instruction and recreation of the public such a typical collection would be of far greater value than any many-acred imitation of Noah's ark.

Lastly comes the question as to when biological study may best be pursued. I do not see any valid reason why it should not be made, to a certain extent, a part of ordinary school training. [290] I have long advocated this view, and I am perfectly certain that it can be carried out with ease, and not only with ease, but with very considerable profit to those who are taught; but then such instruction must be adapted to the minds and needs of the scholars. They used to have a very odd way of teaching the classical languages when I was a boy. The first task set you was to learn the rules of the Latin grammar in the Latin language–that being the language you were going to learn! I thought then that this was an odd way of learning a language, but did not venture to rebel against the judgment of my superiors. Now, perhaps, I am not so modest as I was then, and I allow myself to think that it was a very absurd fashion. But it would be no less absurd, if we were to set about teaching Biology by putting into the hands of boys a series of definitions of the classes and orders of the animal kingdom, and making them repeat them by heart. That is so very favourite a method of teaching, that I sometimes fancy the spirit of the old classical system has entered into the new scientific system, in which case I would much rather that any pretence at scientific teaching were abolished altogether. What really has to be done is to get into the young mind some notion of what animal and vegetable life is. In this matter, you have to consider

practical convenience as well as other things. There are difficulties in [291] the way of a lot of boys making messes with slugs and snails; it might not work in practice. But there is a very convenient and handy animal which everybody has at hand, and that is himself; and it is a very easy and simple matter to obtain common plants. Hence the general truths of anatomy and physiology can be taught to young people in a very real fashion by dealing with the broad facts of human structure. Such viscera as they cannot very well examine in themselves, such as hearts, lungs, and livers, may be obtained from the nearest butcher's shop. In respect to teaching something about the biology of plants, there is no practical difficulty, because almost any of the common plants will do, and plants do not make a mess–at least they do not make an unpleasant mess; so that, in my judgment, the best form of Biology for teaching to very young people is elementary human physiology on the one hand, and the elements of botany on the other; beyond that I do not think it will be feasible to advance for some time to come. But then I see no reason, why, in secondary schools, and in the Science Classes which are under the control of the Science and Art Department–and which I may say, in passing, have in my judgment, done so very much for the diffusion of a knowledge of science over the country–we should not hope to see instruction in the elements of Biology carried out, not perhaps to the same [292] extent, but still upon somewhat the same principle as here. There is no difficulty, when you have to deal with students of the ages of fifteen or sixteen, in practising a little dissection and in getting a notion of, at any rate, the four or five great modifications of the animal form; and the like is true in regard to the higher anatomy of plants.

While, lastly, to all those who are studying biological science with a view to their own edification merely, or with the intention of becoming zoologists or botanists; to all those who intend to pursue physiology–and especially to those who propose to employ the working years of their lives in the practice of medicine–I say that there is no training so fitted, or which may be of such important service to them, as the discipline in practical biological work which I have sketched out as being pursued in the laboratory hard by.

I may add that, beyond all these different classes of persons who may profit by the study of Biology, there is yet one other. I remember, a number of years ago, that a gentleman who was a vehement opponent of Mr. Darwin's views and had written some terrible articles against them, applied to me to know what was the best way in which he could acquaint himself with the strongest arguments in favour of evolution. I wrote back, in all good faith and simplicity, [293] recommending him to go through a course of comparative anatomy and physiology, and then to study development. I am sorry to say he was very much displeased, as people often are with good advice. Notwithstanding this discouraging result, I venture, as a parting word, to repeat the suggestion, and to say to all the more or less acute lay and clerical "paper-philosophers"[7] who venture into the regions of biological controversy–Get a little sound, thorough, practical, elementary instruction in biology.

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[1] See the distinction between the "sciences physiques" and the "sciences physiologiques" in the *Anatomie Générale,* 1801.

[2] *Hydrogéologié,* an. x. (1801).

[3] "The term *Biology,* which means exactly what we wish to express, *the Science of Life,* has often been used, and has of late become not uncommon, among good writers."–Whewell. *Philosophy of the Inductive Science,* vol. i, p.544 (edition of 1847).

[4] I think that my friend, Professor Allman, was the first to draw attention to it.

[5] Galileo was troubled by a sort of people whom he called "paper philosophers," because they fancied that the true reading of nature was to be detected by the collation of tests. The race is not extinct, but, as of old, brings forth its "winds of doctrine" by which the weathercock heads among us are much exercised.

[6] Some critics do not even take the trouble to read. I have recently been adjured with much solemnity, to state publicly why I have "changed my opinion" as to the value of the palæontological evidence of the occurrence of evolution.

To this my reply is, Why should I, when that statement was made seven years ago? An address delivered from the Presidential Chair of the Geological Society, in 1870, may be said to be a public document, inasmuch as it not only appeared in the *Journal* of that learned body, but was re-published, in 1873, in a volume of *Critiques and Addresses,* to which my name is attached. Therein will be found a pretty full statement of my reasons for enunciating two propositions: (1) that "when we turn to the higher *Vertebrata,* the results of recent investigations, however we may sift and criticise them, seem to me to leave a clear balance in favour of the evolution of living forms one from another;" and (2) that the case of the horse is one which "will stand rigorous criticism."

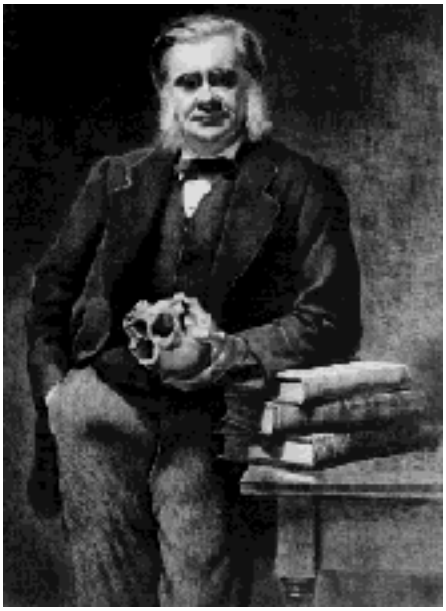
Thus I do not see clearly in what way I can be said to have changed my opinion, except in the way of intensifying it, when in consequence of the accumulation of similar evidence since 1870, I recently spoke of the denial of evolution as not worth serious consideration.

[7] Writers of this stamp are fond of talking about the Baconian method. I beg them therefore to lay to heart these two weighty sayings of the herald of Modern Science:–

"Syllogismus ex propositionibus constat, propositiones ex verbis, verba notionum tesseræ sunt. Itaque si notiones ipsæ' (*id quod basis rei est*) confusæ sint et temere a rebus abstractæ, nihil in iis quæ superstruuntur est firmitudinis."–*Novum Organon,* ii. 14.

"Huic autem vanitati nonnulli ex modernis summa levitate ita indulserunt, ut in primo capitulo Geneseos et in libro Job et aliis scripturis sacris, philosophiam naturalem fundare conati sint; *inter vivos quærentes mortua.*"–*Ibid.* 65.

THE HUXLEY FILE



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Previous article: Address on University Education [1876], pages 235-261.

C. Blinderman & D. Joyce
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On Elementary Instruction in Physiology (1877)

Collected Essays III

[294] The chief ground upon which I venture to recommend that the teaching of elementary physiology should form an essential part of any organised course of instruction in matters pertaining to domestic economy, is, that a knowledge of even the elements of this subject supplies those conceptions of the constitution and mode of action of the living body, and of the nature of health and disease, which prepare the mind to receive instruction from sanitary science.

It is, I think, eminently desirable that the hygienist and the physician should find something in the public mind to which they can appeal; some little stock of universally acknowledged truths, which may serve as a foundation for their warnings and predispose towards an intelligent obedience to their recommendations.

[295] Listening to ordinary talk about health, disease, and death, one is often led to entertain a doubt whether the speakers believe that the course of natural causation runs as smoothly in the human body as elsewhere. Indications are too often obvious of a strong, though perhaps an unavowed and half unconscious, under-current of opinion that the phenomena of life are not only widely different, in their superficial characters and in their practical importance, from other natural events, but that they do not follow in that definite order which characterises the succession of all other occurrences, and the statement of which we call a law of nature.

Hence, I think, arises the want of heartiness of belief in the value of knowledge respecting the laws of health and disease, and of the foresight and care to which knowledge is the essential preliminary, which is so often noticeable; and a corresponding laxity and carelessness in practice, the results of which are too frequently lamentable.

It is said that among the many religious sects of Russia, there is one which holds that all disease is brought about by the direct and special interference of the Deity, and which, therefore, looks with repugnance upon both preventive and curative measures as alike blasphemous interferences with the will of God. Among ourselves, the "Peculiar People" are, I believe, the only persons who hold the like doctrine in its integrity, and carry it out [296] with logical rigour. But many of us are old enough to recollect that the administration of chloroform in assuagement of the pangs of childbirth was, at its introduction, strenuously resisted upon similar grounds.

I am not sure that the feeling, of which the doctrine to which I have referred is the full expression, does not lie at the bottom of the minds of a great many people who yet would vigorously object to give a verbal assent to the doctrine itself. However this may be, the main point is that sufficient knowledge has now been acquired of vital phenomena, to justify the assertion, that the notion, that there is anything exceptional about these phenomena, receives not a particle of support from any known fact. On the

contrary, there is a vast and an increasing mass of evidence that birth and death, health and disease, are as much parts of the ordinary stream of events as the rising and setting of the sun, or the changes of the moon; and that the living body is a mechanism, the proper working of which we term health; its disturbance, disease; its stoppage, death. The activity of this mechanism is dependent upon many and complicated conditions, some of which are hopelessly beyond our control, while others are readily accessible, and are capable of being indefinitely modified by our own actions. The business of the hygienist and of the physician is to know the range of these modifiable conditions, [297] and how to influence them towards the maintenance of health and the prolongation of life; the business of the general public is to give an intelligent assent, and a ready obedience based upon that assent, to the rules laid down for their guidance by such experts. But an intelligent assent is an assent based upon knowledge, and the knowledge which is here in question means an acquaintance with the elements of physiology.

It is not difficult to acquire such knowledge. What is true, to a certain extent, of all the physical sciences, is eminently characteristic of physiology–the difficulty of the subject begins beyond the stage of elementary knowledge, and increases with every stage of progress. While the most highly trained and the best furnished intellect may find all its resources insufficient, when it strives to reach the heights and penetrate into the depths of the problems of physiology, the elementary and fundamental truths can be made clear to a child.

No one can have any difficulty in comprehending the mechanism of circulation or respiration; or the general mode of operation of the organ of vision; though the unravelling of all the minutiæ of these processes, may, for the present, baffle the conjoined attacks of the most accomplished physicists, chemists, and mathematicians. To know the anatomy of the human body, with even an approximation to thoroughness, is the work of a [298] life; but as much as is needed for a sound comprehension of elementary physiological truths, may be learned in a week.

A knowledge of the elements of physiology is not only easy of acquirement, but it may be made a real and practical acquaintance with the facts, as far as it goes. The subject of study is always at hand, in one's self. The principal constituents of the skeleton, and the changes of form of contracting muscles, may be felt through one's own skin. The beating of one's heart, and its connection with the pulse, may be noted; the influence of the valves of one's own veins may be shown; the movements of respiration may be observed; while the wonderful phenomena of sensation afford an endless field for curious and interesting self-study. The prick of a needle will yield, in a drop of one's own blood, material for microscopic observation of phenomena which lie at the foundation of all biological conceptions; and a cold, with its concomitant coughing and sneezing, may prove the sweet uses of adversity by helping one to a clear conception of what is meant by "reflex action."

Of course there is a limit to this physiological self-examination. But there is so close a solidarity between ourselves and our poor relations of the animal world, that our inaccessible inward parts may be supplemented by theirs. A comparative anatomist knows that a sheep's heart and [299] lungs, or eye, must not be confounded with those of a man; but, so far as the comprehension of the elementary facts of the physiology of circulation, of respiration, and of vision goes, the one furnishes the needful anatomical

data as well as the other.

Thus, it is quite possible to give instruction in elementary physiology in such a manner as, not only to confer knowledge, which, for the reason I have mentioned, is useful in itself; but to serve the purposes of a training in accurate observation, and in the methods of reasoning of physical science. But that is an advantage which I mention only incidentally, as the present Conference does not deal with education in the ordinary sense of the word.

It will not be suspected that I wish to make physiologists of all the world. It would be as reasonable to accuse an advocate of the "three R's" of a desire to make an orator, an author, and a mathematician of everybody. A stumbling reader, a pot-hook writer, and an arithmetician who has not got beyond the rule of three, is not a person of brilliant acquirements; but the difference between such a member of society and one who can neither read, write, nor cipher is almost inexpressible; and no one nowadays doubts the value of instruction, even if it goes no farther.

The saying that a little knowledge is a dangerous thing is, to my mind, a very dangerous adage. [300] If knowledge is real and genuine, I do not believe that it is other than a very valuable possession, however infinitesimal its quantity may be. Indeed, if a little knowledge is dangerous, where is the man who has so much as to be out of danger?

If William Harvey's life-long labours had revealed to him a tenth part of that which may be made sound and real knowledge to our boys and girls, he would not only have been what he was, the greatest physiologist of his age, but he would have loomed upon the seventeenth century as a sort of intellectual portent. Our "little knowledge" would have been to him a great, astounding, unlooked-for vision of scientific truth.

I really see no harm which can come of giving our children a little knowledge of physiology. But then, as I have said, the instruction must be real, based upon observation, eked out by good explanatory diagrams and models, and conveyed by a teacher whose own knowledge has been acquired by a study of the facts; and not the mere catechismal parrot-work which too often usurps the place of elementary teaching.

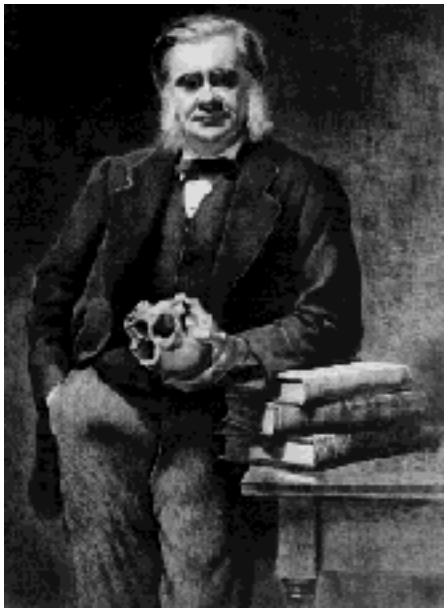
It is, I hope, unnecessary for me to give a formal contradiction to the silly fiction, which is assiduously circulated by fanatics who not only ought to know, but do know, that their assertions are untrue, that I have advocated the introduction of that experimental discipline which is absolutely [301] indispensable to the professed physiologist, into elementary teaching.

But while I should object to any experimentation which can justly be called painful, for the purpose of elementary instruction; and, while, as a member of a late Royal Commission, I gladly did my best to prevent the infliction of needless pain, for any purpose; I think it is my duty to take this opportunity of expressing my regret at a condition of the law which permits a boy to troll for pike, or set lines with live frog bait, for idle amusement; and, at the same time, lays the teacher of that boy open to the penalty of

fine and imprisonment, if he uses the same animal for the purpose of exhibiting one of the most beautiful and instructive of physiological spectacles, the circulation in the web of the foot. No one could undertake to affirm that a frog is not inconvenienced by being wrapped up in a wet rag, and having his toes tied out; and it cannot be denied that inconvenience is a sort of pain. But you must not inflict the least pain on a vertebrated animal for scientific purposes (though you may do a good deal in that way for gain or for sport) without due licence of the Secretary of State for the Home Department, granted under the authority of the Vivisection Act.

So it comes about, that, in this present year of grace 1877, two persons may be charged with cruelty to animals. One has impaled a frog, and [302] suffered the creature to writhe about in that condition for hours; the other has pained the animal no more than one of us would be pained by tying strings round his fingers, and keeping him in the position of a hydropathic patient. The first offender says "I did it because I find fishing very amusing," and the magistrate bids him depart in peace; nay, probably wishes him good sport. The second pleads, "I wanted to impress a scientific truth, with a distinctness attainable in no other way, on the minds of my scholars," and the magistrate fines him five pounds.

I cannot but think that this is an anomalous and not wholly creditable state of things.



On Medical Education (1870)

Collected Essays III

[303] It has given me sincere pleasure to be here today, at the desire of your highly respected President and the Council of the College. In looking back upon my own past, I am sorry to say that I have found that it is a quarter of a century since I took part in those hopes and in those fears by which you have all recently been agitated, and which now are at an end. But, although so long a time has elapsed since I was moved by the same feelings, I beg leave to assure you that my sympathy with both victors and vanquished remains fresh–so fresh, indeed, that I could almost try to persuade myself that, after all, it cannot be so very long ago. My business during the last hour, however, has been to show that sympathy with one side only, and I assure [304] you I have done my best to play my part heartily, and to rejoice in the success of those who have succeeded. Still, I should like to remind you at the end of it all, that success on an occasion of this kind, valuable and important as it is, is in reality only putting the foot upon one rung of the ladder which leads upwards; and that the rung of a ladder was never meant to rest upon, but only to hold a man's foot long enough to enable him to put the other somewhat higher. I trust that you will all regard these successes as simply reminders that your next business is, having enjoyed the success of the day, no longer to look at that success, but to look forward to the next difficulty that is to be conquered. And now, having had so much to say to the successful candidates, you must forgive me if I add that a sort of under-current of sympathy has been going on in my mind all the time for those who have not been successful, for those valiant knights who have been overthrown in your tourney, and have not made their appearance in public. I trust that, in accordance with old custom, they, wounded and bleeding, have been carried off to their tents, to be carefully tended by the fairest of maidens; and in these days, when the chances are that every one of such maidens will be a qualified practitioner, I have no doubt that all the splinters will have been carefully extracted, and that they are now physically healed. But there may [304] remain some little fragment of moral or intellectual discouragement, and therefore I will take the liberty to remark that your chairman to-day, if he occupied his proper place, would be among them. Your chairman, in virtue of his position, and for the brief hour that he occupies that position, is a person of importance; and it may be some consolation to those who have failed if I say, that the quarter of a century which I have been speaking of, takes me back to the time when I was up at the University of London, a candidate for honours in anatomy and physiology, and when I was exceedingly well beaten by my excellent friend, Dr. Ransom, of Nottingham. There is a person here who recollects that circumstance very well. I refer to your venerated teacher and mine, Dr. Sharpey. He was at that time one of the examiners in anatomy and physiology, and you may be quite sure that, as he was one of the examiners, there remained not the smallest doubt in my mind of the propriety of his judgment, and I accepted my defeat with the most comfortable assurance that I had thoroughly well earned it. But, gentlemen, the competitor having been a worthy one, and the examination a fair one, I cannot say that I found in that circumstance anything very discouraging. I said to myself, "Never mind; what's the next thing to be done?" And I found that policy of "never [306] minding" and going on to the next thing to be done, to be the most important of all policies in the conduct of practical life. It does not matter how many tumbles you have in this life, so long as you do not get dirty when you tumble; it is only the people who have to stop to be washed and made clean, who must necessarily lose the race. And I can

assure you that there is the greatest practical benefit in making a few failures early in life. You learn that which is of inestimable importance–that there are a great many people in the world who are just as clever as you are. You learn to put your trust, by and by, in an economy and frugality of the exercise of your powers, both moral and intellectual; and you very soon find out, if you have not found it out before, that patience and tenacity of purpose are worth more than twice their weight of cleverness. In fact, if I were to go on discoursing on this subject, I should become almost eloquent in praise of non-success; but, lest so doing should seem, in any way, to wither well-earned laurels, I will turn from that topic, and ask you to accompany me in some considerations touching another subject which has a very profound interest for me, and which I think ought to have an equally profound interest for you.

I presume that the great majority of those whom I address propose to devote themselves to [306] the profession of medicine; and I do not doubt, from the evidences of ability which have been given to-day, that I have before me a number of men who will rise to eminence in that profession, and who will exert a great and deserved influence upon its future. That in which I am interested, and about which I wish to speak, is the subject of medical education, and I venture to speak about it for the purpose, if I can, of influencing you, who may have the power of influencing the medical education of the future. You may ask, by what authority do I venture, being a person not concerned in the practice of medicine, to meddle with that subject? I can only tell you it is a fact, of which a number of you I dare say are aware by experience (and I trust the experience has no painful associations), that I have been for a considerable number of years (twelve or thirteen years to the best of my recollection) one of the examiners in the University of London. You are further aware that the men who come up to the University of London are the picked men of the medical schools of London, and therefore such observations as I may have to make upon the state of knowledge of these gentlemen, if they be justified, in regard to any faults I may have to find, cannot be held to indicate defects in the capacity, or in the power of application of those gentlemen, but must be laid, more or less, to the account of the prevalent system of medical educa[308] tion. I will tell you what has struck me–but in speaking in this frank way, as one always does about the defects of one's friends, I must beg you to disabuse your minds of the notion that I am alluding to any particular school, or to any particular college, or to any particular person; and to believe that if I am silent when I should be glad to speak with high praise, it is because that praise would come too close to this locality. What has struck me, then, in this long experience of the men best instructed in physiology from the medical schools of London is (with the many and brilliant exceptions to which I have referred), taking it as a whole, and broadly, the singular unreality of their knowledge of physiology. Now, I use that word "unreality" advisedly: I do not say "scanty;" on the contrary, there is plenty of it–a great deal too much of it–but it is the quality, the nature of the knowledge, which I quarrel with. I know I used to have–I don't know whether I have now, but I had once upon a time–a bad reputation among students for setting up a very high standard of acquirement, and I dare say you may think that the standard of this old examiner, who happily is now very nearly an extinct examiner, has been pitched too high. Nothing of the kind, I assure you. The defects I have noticed, and the faults I have to find, arise entirely from the circumstance that my standard is pitched too low. This is no paradox, gentlemen, but quite simply [309] the fact. The knowledge I have looked for was a real, precise, thorough, and practical knowledge of fundamentals; whereas that which the best of the candidates, in a large proportion of cases, have had to give me was a large, extensive, and inaccurate knowledge of superstructure; and that is what I mean by saying that my demands went too low and not too high. What I have had to complain of is, that a large

proportion of the gentlemen who come up for physiology to the University of London do not know it as they know their anatomy, and have not been taught it as they have been taught their anatomy. Now, I should not wonder at all if I heard a great many "No, noes" here; but I am not talking about University College; as I have told you before, I am talking about the average education of medical schools. What I have found, and found so much reason to lament, is, that while anatomy has been taught as a science ought to be taught, as a matter of autopsy, and observation, and strict discipline; in a very large number of cases, physiology has been taught as if it were a mere matter of books and of hearsay. I declare to you, gentlemen, that I have often expected to be told, when I have asked a question about the circulation of the blood, that Professor Breitkopf is of opinion that it circulates, but that the whole thing is an open question. I assure you that I am hardly exaggerating the state of mind on matters of [310] fundamental importance which I have found over and over again to obtain among gentlemen coming up to that picked examination of the University of London. Now, I do not think that is a desirable state of things. I cannot understand why physiology should not be taught–in fact, you have here abundant evidence that it can be taught–with the same definiteness and the same precision as anatomy is taught. And you may depend upon this, that the only physiology which is to be of any good whatever in medical practice, or in its application to the study of medicine, is that physiology which a man knows of his own knowledge; just as the only anatomy which would be of any good to the surgeon is the anatomy which he knows of his own knowledge. Another peculiarity I have found in the physiology which has been current, and that is, that in the minds of a great many gentlemen it has been supplanted by histology. They have learnt a great deal of histology, and they have fancied that histology and physiology are the same things. I have asked for some knowledge of the physics and the mechanics and the chemistry of the human body, and I have been met by talk about cells. I declare to you I believe it will take me two years, at least, of absolute rest from the business of an examiner to hear the word "cell," "germinal matter," or "carmine," without a sort of inward shudder.

[311] Well, now, gentlemen, I am sure my colleagues in this examination will bear me out in saying that I have not been exaggerating the evils and defects which are current–have been current–in a large quantity of the physiological teaching the results of which come before examiners. And it becomes a very interesting question to know how all this comes about, and in what way it can be remedied. How it comes about will be perfectly obvious to any one who has considered the growth of medicine. I suppose that medicine and surgery first began by some savage more intelligent than the rest, discovering that a certain herb was good for a certain pain, and that a certain pull, somehow or other, set a dislocated joint right. I suppose all things had their humble beginnings, and medicine and surgery were in the same condition. People who wear watches know nothing about watchmaking. A watch goes wrong and it stops; you see the owner giving it a shake, or, if he is very bold, he opens the case, and gives the balance-wheel a push. Gentlemen, that is empirical practice, and you know what are the results upon the watch. I should think you can divine what are the results of analogous operations upon the human body. And because men of sense very soon found that such were the effects of meddling with very complicated machinery they did not understand, I suppose the first thing, as being the easiest, was [312] to study the nature of the works of the human watch, and the next thing was to study the way the parts worked together, and the way the watch worked. Thus, by degrees, we have had growing up our body of anatomists, or knowers of the construction of the human watch, and our physiologists, who know how the machine works. And just as any sensible man, who has a valuable watch, does not meddle with it

himself, but goes to some one who has studied watchmaking, and understands what the effect of doing this or that may be; so, I suppose, the man who, having charge of that valuable machine, his own body, wants to have it kept in good order, comes to a professor of the medical art for the purpose of having it set right, believing that, by deduction from the facts of structure and from the facts of function, the physician will divine what may be the matter with his bodily watch at that particular time, and what may be the best means of setting it right. If that may be taken as a just representation of the relation of the theoretical branches of medicine–what we may call the institutes of medicine, to use an old term–to the practical branches, I think it will be obvious to you that they are of prime and fundamental importance. Whatever tends to affect the teaching of them injuriously must tend to destroy and to disorganise the whole fabric of the medical art. I think every sensible man has seen this long ago; [313] but the difficulties in the way of attaining good teaching in the different branches of the theory, or institutes, of medicine are very serious. It is a comparatively easy matter–pray mark that I use the word "comparatively"–it is a comparatively easy matter to learn anatomy and to teach it; it is a very difficult matter to learn physiology and to teach it. It is a very difficult matter to know and to teach those branches of physics and those branches of chemistry which bear directly upon physiology; and hence it is that, as a matter of fact, the teaching of physiology, and the teaching of the physics and the chemistry which bear upon it, must necessarily be in a state of relative imperfection; and there is nothing to be grumbled at in the fact that this relative imperfection exists. But is the relative imperfection which exists only such as is necessary, or is it made worse by our practical arrangements? I believe–and if I did not so believe I should not have troubled you with these observations–I believe it is made infinitely worse by our practical arrangements, or rather, I ought to say, our very unpractical arrangements. Some very wise man long ago affirmed that every question, in the long run, was a question of finance; and there is a good deal to be said for that view. Most assuredly the question of medical teaching is, in a very large and broad sense, a question of finance. What I mean is this: that in London the arrangements of the [314] medical schools, and the number of them, are such as to render it almost impossible that men who confine themselves to the teaching of the theoretical branches of the profession should be able to make their bread by that operation; and, you know, if a man cannot make his bread he cannot teach–at least his teaching comes to a speedy end. That is a matter of physiology. Anatomy is fairly well taught, because it lies in the direction of practice, and a man is all the better surgeon for being a good anatomist. It does not absolutely interfere with the pursuits of a practical surgeon if he should hold a Chair of Anatomy–though I do not for one moment say that he would not be a better teacher if he did not devote himself to practice. (Applause.) Yes, I know exactly what that cheer means, but I am keeping as carefully as possible from any sort of allusion to Professor Ellis. But the fact is, that even human anatomy has now grown to be so large a matter, that it takes the whole devotion of a man's life to put the great mass of knowledge upon that subject into such a shape that it can be teachable to the mind of the ordinary student. What the student wants in a professor is a man who shall stand between him and the infinite diversity and variety of human knowledge, and who shall gather all that together, and extract from it that which is capable of being assimilated by the mind. That function is a vast and an [315] important one, and unless, in such subjects as anatomy, a man is wholly free from other cares, it is almost impossible that he can perform it thoroughly and well. But if it be hardly possible for a man to pursue anatomy without actually breaking with his profession, how is it possible for him to pursue physiology?

I get every year those very elaborate reports of Henle and Meissner–volumes of, I suppose, 400 pages altogether–and they consist merely of abstracts of the memoirs and works which have been written on Anatomy and Physiology–only abstracts of them! How is a man to keep up his acquaintance with all that is doing in the physiological world–in a world advancing with enormous strides every day and every hour–if he has to be distracted with the cares of practice? You know very well it must be impracticable to do so. Our men of ability join our medical schools with an eye to the future. They take the Chairs of Anatomy or of Physiology; and by and by they leave those Chairs for the more profitable pursuits into which they have drifted by professional success, and so they become clothed, and physiology is bare. The result is, that in those schools in which physiology is thus left to the benevolence, so to speak, of those who have no time to look to it, the effect of such teaching comes out obviously, and is made manifest in what I spoke of just now–the unreality, the [316] bookishness of the knowledge of the taught. And if this is the case in physiology, still more must it be the case in those branches of physics which are the foundation of physiology; although it may be less the case in chemistry, because for an able chemist a certain honourable and independent career lies in the direction of his work, and he is able, like the anatomist, to look upon what he may teach to the student as not absolutely taking him away from his bread-winning pursuits.

But it is of no use to grumble about this state of things unless one is prepared to indicate some sort of practical remedy. And I believe–and I venture to make the statement because I am wholly independent of all sorts of medical schools, and may, therefore, say what I believe without being supposed to be affected by any personal interest–but I say I believe that the remedy for this state of things, for that imperfection of our theoretical knowledge which keeps down the ability of England at the present time in medical matters, is a mere affair of mechanical arrangement; that so long as you have a dozen medical schools scattered about in different parts of the metropolis, and dividing the students among them, so long, in all the smaller schools at any rate, it is impossible that any other state of things than that which I have been depicting should obtain. Professors must live; to live they [317] must occupy themselves with practice, and if they occupy themselves with practice, the pursuit of the abstract branches of science must go to the wall. All this is a plain and obvious matter of common-sense reasoning. I believe you will never alter this state of things until, either by consent or by *force majeure*–and I should be very sorry to see the latter applied–but until there is some new arrangement, and until all the theoretical branches of the profession, the institutes of medicine, are taught in London in not more than one or two, or at the outside three, central institutions, no good will be effected. If that large body of men, the medical students of London, were obliged in the first place to get a knowledge of the theoretical branches of their profession in two or three central schools, there would be abundant means for maintaining able professors–not, indeed, for enriching them, as they would be able to enrich themselves by practice–but for enabling them to make that choice which such men are so willing to make; namely, the choice between wealth and a modest competency, when that modest competency is to be combined with a scientific career, and the means of advancing knowledge. I do not believe that all the talking about, and tinkering of, medical education will do the slightest good until the fact is clearly recognised, that men must be thoroughly grounded in the theoretical branches [318] of their profession, and that to this end the teaching of those theoretical branches must be confined to two or three centres.

Now let me add one other word, and that is that if I were a despot, I would cut down these branches to a

very considerable extent. The next thing to be done beyond that which I mentioned just now, is to go back to primary education. The great step toward a thorough medical education is to insist upon the teaching of the elements of the physical sciences in all schools, so that medical students shall not go up to the medical colleges utterly ignorant of that with which they have to deal; to insist on the elements of chemistry, the elements of botany, and the elements of physics being taught in our ordinary and common schools, so that there shall be some preparation for the discipline of medical colleges. And, if this reform were once effected, you might confine the "Institutes of Medicine" to physics as applied to physiology–to chemistry as applied to physiology–to physiology itself, and to anatomy. Afterwards, the student, thoroughly grounded in these matters, might go to any hospital he pleased for the purpose of studying the practical branches of his profession. The practical teaching might be made as local as you like; and you might use to advantage the opportunities afforded by all these local institutions for acquiring a knowledge of the practice of the profession. But you may say: [319] "This is abolishing a great deal; you are getting rid of botany and zoology to begin with." I have not a doubt that they ought to be got rid of, as branches of special medical education; they ought to be put back to an earlier stage, and made branches of general education. Let me say, by way of self-denying ordinance, for which you will, I am sure, give me credit, that I believe that comparative anatomy ought to be absolutely abolished. I say so, not without a certain fear of the Vice-Chancellor of the University of London who sits upon my left. But I do not think the charter gives him very much power over me; moreover, I shall soon come to an end of my examinership, and therefore I am not afraid, but shall go on to say what I was going to say, and that is, that in my belief it is a downright cruelty–I have no other word for it–to require from gentlemen who are engaged in medical studies, the pretence–for it is nothing else, and can be nothing else, than a pretence–of a knowledge of comparative anatomy as part of their medical curriculum. Make it part of their Arts teaching if you like, make it part of their general education if you like, make it part of their qualification for the scientific degree by all means–that is its proper place; but to require that gentlemen whose whole faculties should be bent upon the acquirement of a real knowledge of human physiology should worry themselves with getting up [320] hearsay about the alternation of generations in the Salpæ is really monstrous. I cannot characterise it in any other way. And having sacrificed my own pursuit, I am sure I may sacrifice other people's; and I make this remark with all the more willingness because I discovered, on reading the names of your Professors just now, that the Professor of Materia Medica is not present. I must confess, if I had my way I should abolish Materia Medica altogether.[1] I recollect, when I was first under examination at the University of London, Dr. Pereira was the examiner, and you know that Pereira's "Materia Medica" was a book *de omnibus rebus.* I recollect my struggles with that book late at night and early in the morning (I worked very hard in those days), and I do believe that I got that book into my head somehow or other, but then I will undertake to say that I forgot it all a week afterwards. Not one trace of a knowledge of drugs has remained in my memory from that time to this; and really, as a matter of common sense, I cannot understand the arguments for obliging a medical man to know all about drugs and where they come from. Why not make him belong to the Iron and Steel Institute, and learn something about cutlery, because he uses knives?

But do not suppose that, after all these deduc[321]tions, there would not be ample room for your activity. Let us count up what we have left. I suppose all the time for medical education that can be hoped for is, at the outside, about four years. Well, what have you to master in those four years upon my supposition? Physics applied to physiology; chemistry applied to physiology; physiology; anatomy;

surgery; medicine (including therapeutics); obstetrics; hygiene; and medical jurisprudence–nine subjects for four years! And when you consider what those subjects are, and that the acquisition of anything beyond the rudiments of any one of them may tax the energies of a lifetime, I think that even those energies which you young gentlemen have been displaying for the last hour or two might be taxed to keep you thoroughly up to what is wanted for your medical career.

I entertain a very strong conviction that any one who adds to medical education one iota or tittle beyond what is absolutely necessary, is guilty of a very grave offence. Gentlemen, it will depend upon the knowledge that you happen to possess,–upon your means of applying it within your own field of action,–whether the bills of mortality of your district are increased or diminished; and that, gentlemen, is a very serious consideration indeed. And, under those circumstances the subjects with which you have to deal being so difficult, their extent so enormous, and [322] the time at your disposal so limited, I could not feel my conscience easy if I did not, on such an occasion as this, raise a protest against employing your energies upon the acquisition of any knowledge which may not be absolutely needed in your future career.

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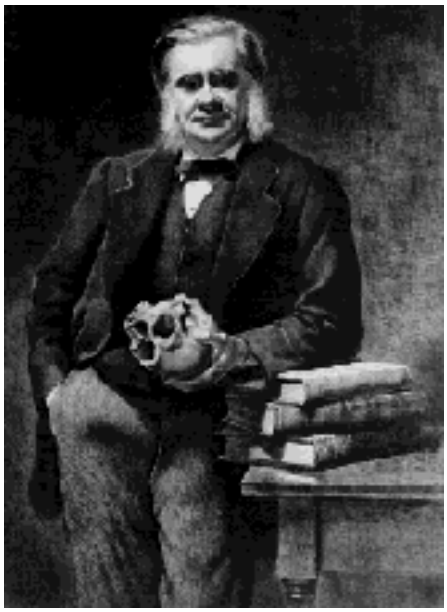
[1] It will, I hope, be understood that I do not include Therapeutics under this head.



The State and the Medical Profession (1884)

Collected Essays III

[323] At intervals during the last quarter of a century committees of the Houses of the Legislature and specially appointed commissions have occupied themselves with the affairs of the medical profession. Much evidence has been taken, much wrangling has gone on over the reports of these bodies; and sometimes much trouble has been taken to get measures based upon all this work through Parliament, but very little has been achieved.

The Bill introduced last session was not more fortunate than several predecessors. I suppose that it is not right to rejoice in the misfortunes of anything, even a Bill; but I confess that this event afforded me lively satisfaction, for I was a member of the Royal Commission on the report [324] of which the Bill was founded, and I did my best to oppose and nullify that report.

That the question must be taken up again and finally dealt with by the Legislature before long cannot be doubted; but in the meanwhile there is time for reflection, and I think that the non-medical public would be wise if they paid a little attention to a subject which is really of considerable importance to them.

The first question which a plain man is disposed to ask himself is, Why should the State interfere with the profession of medicine any more than it does, say, with the profession of engineering? Anybody who pleases may call himself an engineer, and may practice as such. The State confers no title upon engineers, and does not profess to tell the public that one man is a qualified engineer and that another is not so.

The answers which are given to the question are various, and most of them, I think, are bad. A large number of persons seem to be of opinion that the State is bound no less to take care of the general public, than to see that it is protected against incompetent persons, against quacks and medical impostors in general. I do not take that view of the case. I think it is very much wholesomer for the public to take care of itself in this as in all other matters; and although I am not such a fanatic for the liberty of the subject as to plead that interfering with the way in which a [325] man may choose to be killed is a violation of that liberty, yet I do think that it is far better to let everybody do as he likes. Whether that be so or not, I am perfectly certain that, as a matter of practice, it is absolutely impossible to prohibit the practice of medicine by people who have no special qualification for it. Consider the terrible consequences of attempting to prohibit practice by a very large class of persons who are certainly not technically qualified–I am far from saying a word as to whether they are otherwise qualified or not. The number of Ladies Bountiful–grandmothers, aunts, and mothers-in-law–whose chief delight lies in the administration of their cherished provision of domestic medicine, is past computation, and one shudders to think of what might happen if their energies were turned from this innocuous, if not beneficent channel, by the strong arm of the law. But the thing is impracticable.

Another reason for intervention is propounded, I am sorry to say, by some, though not many, members of the medical profession, and is simply an expression of that trades unionism which tends to infest professions no less than trades.

The general practitioner trying to make both ends meet on a poor practice, whose medical training has cost him a good deal of time and money, finds that many potential patients, whose small fees would be welcome as the little that helps, prefer to go and get their shilling's worth of [326] "doctor's stuff" and advice from the chemist and druggist round the corner, who has not paid sixpence for his medical training, because he has never had any.

The general practitioner thinks this is very hard upon him and ought to be stopped. It is perhaps natural that he should think so, though it would be very difficult for him to justify his opinion on any ground of public policy. But the question is really not worth discussion, as it is obvious that it would be utterly impracticable to stop the practice "over the counter" even if it were desirable.

Is a man who has a sudden attack of pain in tooth or stomach not to be permitted to go to the nearest druggist's shop and ask for something that will relieve him? The notion is preposterous. But if this is to be legal, the whole principle of the permissibility of counter practice is granted.

In my judgment the intervention of the State in the affairs of the medical profession can be justified not upon any pretence of protecting the public, and still less upon that of protecting the medical profession, but simply and solely upon the fact that the State employs medical men for certain purposes, and, as employer, has a right to define the conditions on which it will accept service. It is for the interest of the community that no person shall die without there being some official recognition of the cause of his death. It is a matter of the [327] highest importance to the community that, in civil and criminal cases, the law shall be able to have recourse to persons whose evidence may be taken as that of experts; and it will not be doubted that the State has a right to dictate the conditions under which it will appoint persons to the vast number of naval, military, and civil medical offices held directly or indirectly under the Government. Here, and here only, it appears to me, lies the justification for the intervention of the State in medical affairs. It says, or, in my judgment, should say, to the public, "Practice medicine if you like–go to be practised upon by anybody;" and to the medical practitioner, "Have a qualification, or do not have a qualification if people don't mind it; but if the State is to receive your certificate of death, if the State is to take your evidence as that of an expert, if the State is to give you any kind of civil, or military, or naval appointment, then we can call upon you to comply with our conditions, and to produce evidence that you are, in our sense of the word, qualified. Without that we will not place you in that position." As a matter of fact, that is the relation of the State to the medical profession in this country. For my part, I think it an extremely healthy relation; and it is one that I should be very sorry to see altered, except in so far that it would certainly be better if greater facilities were given for the swift and sharp punishment of those who pro[328]fess to have the State qualification when, in point of fact, they do not possess it. They are simply cheats and swindlers, like other people who profess to be what they are not, and should be punished as such.

But supposing we are agreed about the justification of State intervention in medical affairs, new questions arise as to the manner in which that intervention should take place and the extent to which it should go, on which the divergence of opinion is even greater than it is on the general question of intervention.

It is now, I am sorry to say, something over forty years since I began my medical studies; and, at that time, the state of affairs was extremely singular. I should think it hardly possible that it could have obtained anywhere but in such a country as England, which cherishes a fine old crusted abuse as much as it does its port wine. At that time there were twenty-one licensing bodies–that is to say, bodies whose certificate was received by the State as evidence that the persons who possessed that certificate were medical experts. How these bodies came to possess these powers is a very curious chapter in history, in which it would be out of place to enlarge. They were partly universities, partly medical guilds and corporations, partly the Archbishop of Canterbury. Those were the three sources from which the licence to practice came in that day. There was [329] no central authority, there was nothing to prevent any one of those licensing authorities from granting a licence to any one upon any conditions it thought fit. The examination might be a sham, the curriculum might be a sham, the certificate might be bought and sold like anything in a shop; or, on the other hand, the examination might be fairly good and the diploma correspondingly valuable; but there was not the smallest guarantee, except the personal character of the people who composed the administration of each of these licensing bodies, as to what might happen. It was possible for a young man to come to London and to spend two years and six months of the time of his compulsory three years "walking the hospitals" in idleness or worse; he could then, by putting himself in the hands of a judicious "grinder" for the remaining six months, pass triumphantly through the ordeal of one hour's *vivâ voce* examination, which was all that was absolutely necessary, to enable him to be turned loose upon the public, like death on the pale horse, "conquering and to conquer," with the full sanction of the law, as a "qualified practitioner."

It is difficult to imagine, at present, such a state of things, still more difficult to depict the consequences of it, because they would appear like a gross and malignant caricature; but it may be said that there was never a system, or want of system, which was better calculated to ruin [330] the students who came under it, or to degrade the profession as a whole. My memory goes back to a time when models from whom the Bob Sawyer of the *Pickwick Papers* might have been drawn were anything but rare.

Shortly before my student days, however, the dawn of a better state of things in England began to be visible, in consequence of the establishment of the University of London, and the comparatively very high standard which it placed before its medical graduates.

I say comparatively high standard, for the requirements of the University in those days, and even during the twelve years at a later period, when I was one of the examiners of the medical faculty, were such as would not now be thought more than respectable, and indeed were in many respects very imperfect. But, relatively to the means of learning, the standard was high, and none but the more able and ambitious of the students dreamed of passing the University. Nevertheless, the fact that many men of this stamp did succeed in obtaining their degrees, led others to follow in their steps, and slowly but surely reacted upon the standard of teaching in the better medical schools. Then came the Medical Act of 1858. That Act

introduced two immense improvements: one of them was the institution of what is called the Medical Register, upon which the names of all persons recognised [331] by the State as medical practitioners are entered: and the other was the establishment of the Medical Council, which is a kind of Medical Parliament, composed of representatives of the licensing bodies and of leading men in the medical profession nominated by the Crown. The powers given by the Legislature to the Medical Council were found practically to be very limited, but I think that no fair observer of the work will doubt that this much attacked body has excited no small influence in bringing about the great change for the better, which has been effected in the training of men for the medical profession within my recollection.

Another source of improvement must be recognised in the Scottish Universities, and especially in the medical faculty of the University of Edinburgh. The medical education and examinations of this body were for many years the best of their kind in these islands, and I doubt if, at the present moment, the three kingdoms can show a better school of medicine than that of Edinburgh. The vast number of medical students at that University is sufficient evidence of the opinion of those most interested in this subject.

Owing to all these influences, and to the revolution which has taken place in the course of the last twenty years in our conceptions of the proper method of teaching physical science, the training of the medical student in a good school, and the [332] examination test applied by the great majority of the present licensing bodies, reduced now to nineteen, in consequence of the retirement of the Archbishop and the fusion of two of the other licensing bodies, are totally different from what they were even twenty years ago.

I was perfectly astonished, upon one of my sons commencing his medical career the other day, when I contrasted the carefully-watched courses of theoretical and practical instruction, which he is expected to follow with regularity and industry, and the number and nature of the examinations which he will have to pass before he can receive his licence, not only with the monstrous laxity of my own student days, but even with the state of things which obtained when my term of office as examiner in the University of London expired some sixteen years ago.

I have no hesitation in expressing the opinion, which is fully borne out by the evidence taken before the late Royal Commission, that a large proportion of the existing licensing bodies grant their licence on conditions which ensure quite as high a standard as it is practicable or advisable to exact under present circumstances, and that they show every desire to keep pace with the improvements of the times. And I think there can be no doubt that the great majority have so much improved their ways, that their standard is far above that of the ordinary qualification thirty [333] years ago, and I cannot see what excuse there would be for meddling with them if it were not for two other defects which have to be remedied.

Unfortunately there remain two or three black sheep–licensing bodies which simply trade upon their privilege, and sell the cheapest wares they can for shame's sake supply to the bidder. Another defect in the existing system, even where the examination has been so greatly improved as to be good of its kind, is that there are certain licensing bodies which give a qualification for an acquaintance with either

medicine or surgery alone, and which more or less ignore obstetrics. This is a revival of the archaic condition of the profession when surgical operations were mostly left to the barbers and obstetrics to the midwives, and when the physicians thought themselves, and were considered by the world, the "superior persons" of the profession. I remember a story was current in my young days of a great court physician who was travelling with a friend, like himself, bound on a visit to a country house. The friend fell down in an apoplectic fit, and the physician refused to bleed him because it was contrary to professional etiquette for a physician to perform that operation. Whether the friend died or whether he got better because he was not bled I do not remember, but the moral of the story is the same. On the other hand, a [334] famous surgeon was asked whether he meant to bring up his son to his own calling; "No," he said, "he is such a fool, I mean to make a physician of him."

Nowadays, it is happily recognised that medicine is one and indivisible, and that no one can properly practice one branch who is not familiar with at any rate the principles of all. Thus the two great things that are wanted now are, in the first place, some means of enforcing such a degree of uniformity upon all the examining bodies that none should present a disgracefully low minimum or pass examination; and the second point is that some body or other shall have the power of enforcing upon every candidate for the licence to practice the study of the three branches, what is called the tripartite qualification. All the members of the late commission were agreed that these were the main points to be attended to in any proposals for the further improvement of medical training and qualification.

But such being the ends in view, our notions as to the best way of attaining them were singularly divergent; so that it came about that eleven commissioners made seven reports. There was one main majority report and six minor reports, which differed more or less from it, chiefly as to the best method of attaining these two objects.

The majority report recommended the adoption of what is known as the conjoint scheme. [335] According to this plan the power of granting a licence to practise is to be taken away from all the existing bodies, whether they have done well or ill, and to be placed in the hands of a body of delegates (divisional boards), one for each of the three kingdoms. The licence to practise is to be conferred by passing the delegate examination. The licensee may afterwards, if he pleases, go before any of the existing bodies and indulge in the luxury of another examination and the payment of another fee in order to obtain a title, which does not legally place him in any better position than that which he would occupy without it.

Under these circumstances, of course, the only motive for obtaining the degree of a University or the licence of a medical corporation would be the prestige of these bodies. Hence the "black sheep" would certainly be deserted, while those bodies which have acquired a reputation by doing their duty would suffer less.

But, as the majority report proposes that the existing bodies should be compensated for any loss they might suffer out of the fees of the examiners for the State licence, the curious result would be brought about that the profession of the future would be taxed, for all time, for the purpose of handing over to

wholly irresponsible bodies a sum, the amount of which would be large for those who had failed in their duty and small for those who had done it.

[336] The scheme in fact involved a perpetual endowment of the "black sheep," calculated on the maximum of their ill-gained profits.[1] I confess that I found myself unable to assent to a plan which, in addition to the rewarding the evil doers, proposed to take away the privileges of a number of examining bodies which confessedly were doing their duty well, for the sake of getting rid of a few who had failed. It was too much like the Chinaman's device of burning down his house to obtain a poor dish of roast pig–uncertain whether in the end he might not find a mere mass of cinders. What we do know is that the great majority of the existing licensing bodies have marvellously improved in the course of the last twenty years, and are improving. What we do not know is that the complicated scheme of the divisional boards will ever be got to work at all.

My own belief is that every necessary reform may be effected, without any interference with vested interests, without any unjust interference with the prestige of institutions which have been, [337] and still are, extremely valuable, without any question of compensation arising, and by an extremely simple operation. It is only necessary in fact to add a couple of clauses to the Medical Act to this effect: (1) That from and after such a date no person shall be placed upon the Medical Register unless he possesses the threefold qualification. (2) That from and after this date no examination shall be accepted as satisfactory from any licensing body except such as has been carried on in part by examiners appointed by the licensing body, and in part by coadjutor-examiners of equal authority appointed by. the Medical Council or other central authority, and acting under their instructions.

In laying down a rule of this kind the State confiscates nothing, and meddles with nobody, but simply acts within its undoubted right of laying down the conditions under which it will confer certain privileges upon medical practitioners. No one can say that the State has not the right to do this; no one can say that the State interferes with any private enterprise or corporate interest unjustly, in laying down its own conditions for its own service. The plan would have the further advantage that all those corporate bodies which have obtained (as many of them have) a great and just prestige by the admirable way in which they have done their work, would reap their just reward in the [338] thronging of students, thenceforward as formerly, to obtain their qualifications; while those who have neglected their duties, who have in some one or two cases, I am sorry to say, absolutely disgraced themselves, would sink into oblivion, and come to a happy and natural euthanasia, in which their misdeeds and themselves would be entirely forgotten.

Two of my colleagues, Professor Turner and Mr. Bryce, M.P., whose practical familiarity with examinations gave their opinions a high value, expressed their substantial approval of this scheme, and I am unable to see the weight of the objections urged against it. It is urged that the difficulty and expense of adequately inspecting so many examinations and of guaranteeing their efficiency would be great, and the difficulty in the way of a fair adjustment of the representation of existing interests and of the representation of new interests upon the general Medical Council would be almost insuperable.

The latter objection is unintelligible to me. I am not aware that any attempt at such adjustment has been fairly discussed, and until that has been done it may be well not to talk about insuperable difficulties. As to the notion that there is any difficulty in getting the coadjutor-examiners, or that the expense will be overwhelming, we have the experience of Scotland, in which every University does, at the present time, appoint its [339] coadjutor-examiners, who do their work just in the way proposed.

Whether in the way I have proposed, or by the Conjoint Scheme, however, this is perfectly certain: the two things I refer to have to be done: you must have the threefold qualification; you must have the limitation of the minimum qualification also; and any scheme for the improvement of the relations of the State to medicine which does not profess to do these two things thoroughly and well, has no chance of finality.

But when these reforms are witnessed, when there is a Medical Council armed with a more real authority than it at present possesses; when a license to practice cannot be obtained without the threefold qualification; and when an even minimum of qualification is exacted for every licence, is there anything else that remains that any one seriously interested in the welfare of the medical profession, as I may most conscientiously declare myself to be, would like to see done? I think there are three things.

In the first place, even now, when a four years' curriculum is required, the time allotted for medical education is too brief. A young man of eighteen beginning to study medicine is probably absolutely ignorant of the existence of such a thing as anatomy, or physiology, or indeed of any branch of physical science. He comes into an [340] entirely new world; he addresses himself to a kind of work of which he has not the smallest experience. Up to that time his work has been with books; he rushes suddenly into work with things, which is as different from work with books as anything can well be. I am quite sure that a very considerable number of young men spend a very large portion of their first session in simply learning how to learn subjects which are entirely new to them. And yet recollect that in this period of four years they have to acquire a knowledge of all the branches of a great and responsible practical calling of medicine, surgery, obstetrics, general pathology, medical jurisprudence, and so forth. Anybody who knows what these things are, and who knows what is the kind of work which is necessary to give a man the confidence which will enable him to stand at the bedside and say to the satisfaction of his own conscience what shall be done, and what shall not be done, must be aware that if a man has only four years to do all that in he will not have much time to spare. But that is not all. As I have said, the young man comes up, probably ignorant of the existence of science; he has never heard a word of chemistry, he has never heard a word of physics, he has not the smallest conception of the outlines of biological science; and all these things have to be learned as well and crammed into the time which in itself is barely sufficient to acquire [341] a fair amount of that knowledge which is requisite for the satisfactory discharge of his professional duties.

Therefore it is quite clear to me that, somehow or other, the curriculum must be lightened. It is not that any of the subjects which I have mentioned need not to be studied, and may be eliminated. The only alternative therefore is to lengthen the time given to study. Everybody will agree with me that the practical necessities of life in this country are such that, for the average medical practitioner at any rate, it is hopeless to think of extending the period of professional study beyond the age of twenty-two. So

that as the period of study cannot be extended forwards, the only thing to be done is to extend it backwards.

The question is how this can be done. My own belief is that if the Medical Council, instead of insisting upon that examination in general education which I am sorry to say I believe to be entirely futile, were to insist upon a knowledge of elementary physics, and chemistry, and biology, they would be taking one of the greatest steps which at present can be made for the improvement of medical education. And the improvement would be this. The great majority of the young men who are going into the profession have practically completed their general education–or they might very well have done so–by the age [342] of sixteen or seventeen. If the interval between this age and that at which they commence their purely medical studies were employed in obtaining a practical acquaintance with elementary physics, chemistry, and biology, in my judgment it would be as good as two years added to the course of medical study. And for two reasons: in the first place, because the subject-matter of that which they would learn is germane to their future studies, and is so much gained; in the second place, because you might clear out of the course of their professional study a great deal which at present occupies time and attention; and last, but not least–probably most–they would then come to their medical studies prepared for that learning from Nature which is what they have to do in the course of becoming skilful medical men, and for which at present they are not in the slightest degree prepared by their previous education.

The second wish I have to express concerns London especially, and I may speak of it briefly as a more economical use of the teaching power in the medical schools. At this present time every great hospital in London–and there are ten or eleven of them–has its complete medical school, in which not only are the branches of practical medicine taught, but also those studies in general science, such as chemistry, elementary physics, general anatomy, and a variety of other [343] topics which are what used to be called (and the term was an extremely useful one) the institutes of medicine. That was all very well half a century ago; it is all very ill now, simply because those general branches of science, such as anatomy, physiology, chemistry, physiological chemistry, physiological physics, and so forth, have now become so large, and the mode of teaching them is so completely altered, that it is absolutely impossible for any man to be a thoroughly competent teacher of them, or for any student to be effectually taught without the devotion of the whole time of the person who is engaged in teaching. I undertake to say that it is hopelessly impossible for any man at the present time to keep abreast with the progress of physiology unless he gives his whole mind to it; and the bigger the mind is, the more scope he will find for its employment. Again, teaching has become, and must become still more, practical, and that also involves a large expenditure of time. But if a man is to give his whole time to my business he must live by it, and the resources of the schools do not permit them to maintain ten or eleven physiological specialists.

If the students in their first one or two years were taught the institutes of medicine, in two or three central institutions, it would be perfectly easy to have those subjects taught thoroughly and effectually by persons who gave their whole [344] mind and attention to the subject; while at the same time the medical schools at the hospitals would remain what they ought to be–great institutions in which the largest possible opportunities are laid open for acquiring practical acquaintance with the phenomena of disease. So that the preliminary or earlier half of medical education would take place in the central institutions, and the final half would be devoted altogether to practical studies in the hospitals.

I happen to know that this conception has been entertained, not only by myself, but by a great many of those persons who are most interested in the improvement of medical study for a considerable number of years. I do not know whether anything will come of it this half-century or not; but the thing has to be done. It is not a speculative notion; it lies patent to everybody who is accustomed to teaching, and knows what the necessities of teaching are; and I should very much like to see the first step taken–people making up their minds that it has to be done somehow or other.

The last point to which I may advert is one which concerns the action of the profession itself more than anything else. We have arrangements for teaching, we have arrangements for the testing of qualifications, we have marvellous aids and appliances for the treatment of disease in all sorts of ways; but I do not find in London at the present [345] time, in this little place of four or five million inhabitants which supports so many things, any organisation or any arrangement for advancing the science of medicine, considered as a pure science. I am quite aware that there are medical societies of various kinds; I am not ignorant of the lectureships at the College of Physicians and the College of Surgeons; there is the Brown Institute; and there is the Society for the Advancement of Medicine by Research, but there is no means, so far as I know, by which any person who has the inborn gifts of the investigator and discoverer of new truth, and who desires to apply that to the improvement of medical science, can carry out his intention. In Paris there is the University of Paris, which gives degrees; but there are also the Sorbonne and the Collége de France; places in which professoriates are established for the express purpose of enabling men who have the power of investigation, the power of advancing knowledge and thereby reacting on practice, to do that which it is their special mission to do. I do not know of anything of the kind in London; and if it should so happen that a Claude Bernard or a Ludwig should turn up in London, I really have not the slightest notion of what we could do with him. We could not turn him to account, and I think we should have to export him to Germany or France. I doubt whether that is a good or a wise condition of things. I do not think it is a condition of things [346] which can exist for any great length of time, now that people are every day becoming more and more awake to the importance of scientific investigation and to the astounding and unexpected manner in which it everywhere reacts upon practical pursuits. I should look upon the establishment of some institution of that kind as a recognition on the part of the medical profession in general, that if their great and beneficent work is to be carried on, they must, like other people who have great and beneficent work to do, contribute to the advancement of knowledge in the only way in which experience shows that it can be advanced.

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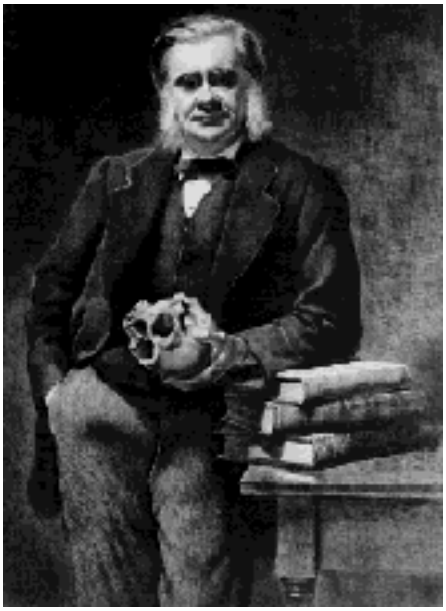
[1] The fees to be paid by candidates for admission to the examinations of the Divisional Board should be of such an amount as will be sufficient to cover the cost of the examinations and the other expenses of the Divisional Board, *and also to provide the sum required to compensate the medical authorities, or such of them as may be entitled to compensation, for any pecuniary losses they may hereafter sustain by reason of the abolition of their privilege of conferring a licence to practise. Report* 50, p. xii.

THE HUXLEY FILE



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The Connection of the Biological Sciences with Medicine (1881)

Collected Essays III

[347] The great body of theoretical and practical knowledge which has been accumulated by the labours of some eighty generations, since the dawn of scientific thought in Europe, has no collective English name to which an objection may not be raised; and I use the term "medicine" as that which is least likely to be misunderstood; though, as every one knows, the name is commonly applied, in a narrower sense, to one of the chief divisions of the totality of medical science.

Taken in this broad sense, "medicine" not merely denotes a kind of knowledge, but it comprehends the various applications of that knowledge to the alleviation of the sufferings, the repair of the injuries, and the conservation of the health, of [348] living beings. In fact, the practical aspect of medicine so far dominates over every other, that the "Healing Art" is one of its most widely-received synonyms. It is so difficult to think of medicine otherwise than as something which is necessarily connected with curative treatment, that we are apt to forget that there must be, and is, such a thing as a pure science of medicine–a "pathology" which has no more necessary subservience to practical ends than has zoology or botany.

The logical connection between this purely scientific doctrine of disease, or pathology, and ordinary biology, is easily traced. Living matter is characterised by its innate tendency to exhibit a definite series of the morphological and physiological phenomena which constitute organisation and life. Given a certain range of conditions, and these phenomena remain the same, within narrow limits, for each kind of living thing. They furnish the normal and typical character of the species, and, as such, they are the subject-matter of ordinary biology.

Outside the range of these conditions, the normal course of the cycle of vital phenomena is disturbed; abnormal structure makes its appearance, or the proper character and mutual adjustment of the functions cease to be preserved. The extent and the importance of these deviations from the typical life may vary indefinitely. They may have no noticeable influence on the general well-being of [349] the economy, or they may favour it. On the other hand, they may be of such a nature as to impede the activities of the organism, or even to involve its destruction.

In the first case, these perturbations are ranged under the wide and somewhat vague category of "variations"; in the second, they are called lesions, states of poisoning, or diseases; and, as morbid states, they lie within the province of pathology. No sharp line of demarcation can be drawn between the two classes of phenomena. No one can say where anatomical variations end and tumours begin, nor where modification of function, which may at first promote health, passes into disease. All that can be said is, that whatever change of structure or function is hurtful belongs to pathology. Hence it is obvious that pathology is a branch of biology; it is the morphology, the physiology, the distribution, the ætiology of abnormal life.

However obvious this conclusion may be now, it was nowise apparent in the infancy of medicine. For it is a peculiarity of the physical sciences that they are independent in proportion as they are imperfect; and it is only as they advance that the bonds which really unite them all become apparent. Astronomy had no manifest connection with terrestrial physics before the publication of the "Principia"; that of chemistry with physics is of still more modern revelation; that of physics and chemistry with physiology, has been stoutly [350] denied within the recollection of most of us, and perhaps still may be.

Or, to take a case which affords a closer parallel with that of medicine. Agriculture has been cultivated from the earliest times, and, from a remote antiquity, men have attained considerable practical skill in the cultivation of the useful plants, and have empirically established many scientific truths concerning the conditions under which they flourish. But, it is within the memory of many of us, that chemistry on the one hand, and vegetable physiology on the other, attained a stage of development such that they were able to furnish a sound basis for scientific agriculture. Similarly, medicine took its rise in the practical needs of mankind. At first, studied without reference to any other branch of knowledge, it long maintained, indeed still to some extent maintains, that independence. Historically, its connection with the biological sciences has been slowly established, and the full extent and intimacy of that connection are only now beginning to be apparent. I trust I have not been mistaken in supposing that an attempt to give a brief sketch of the steps by which a philosophical necessity has become an historical reality, may not be devoid of interest, possibly of instruction, to the members of this great congress, profoundly interested as all are in the scientific development of medicine.

[351] The history of medicine is more complete and fuller than that of any other science, except, perhaps, astronomy; and, if we follow back the long record as far as clear evidence lights us, we find ourselves taken to the early stages of the civilisation of Greece. The oldest hospitals were the temples of Æsculapius; to these Asclepeia, always erected on healthy sites, hard by fresh springs and surrounded by shady groves, the sick and the maimed resorted to seek the aid of the god of health. Votive tablets or inscriptions recorded the symptoms, no less than the gratitude, of those who were healed; and, from these primitive clinical records, the half-priestly, half-philosophic caste of the Asclepiads compiled the data upon which the earliest generalisations of medicine, as an inductive science, were based.

In this state, pathology, like all the inductive sciences at their origin, was merely natural history; it registered the phenomena of disease, classified them, and ventured upon a prognosis, wherever the observation of constant co-existence and sequences suggested a rational expectation of the like recurrence under similar circumstances.

Further than this it hardly went. In fact, in the then state of knowledge, and in the condition of philosophical speculation at that time, neither the causes of the morbid state, nor the *rationale* of treatment, were likely to be sought for as we [352] seek for them now. The anger of a god was a sufficient reason for the existence of a malady, and a dream ample warranty for therapeutic measures; that a physical phenomenon must needs have a physical cause was not the implied or expressed axiom that it is to us moderns.

The great man whose name is inseparably connected with the foundation of medicine, Hippocrates, certainly knew very little, indeed practically nothing, of anatomy or physiology; and he would, probably, have been perplexed even to imagine the possibility of a connection between the zoological studies of his contemporary Democritus and medicine. Nevertheless, in so far as he, and those who worked before and after him, in the same spirit, ascertained, as matters of experience, that a wound, or a luxation, or a fever, presented such and such symptoms, and that the return of the patient to health was facilitated by such and such measures, they established laws of nature, and began the construction of the science of pathology. All true science begins with empiricism–though all true science is such exactly, in so far as it strives to pass out of the empirical stage into that of the deduction of empirical from more general truths. Thus, it is not wonderful, that the early physicians had little or nothing to do with the development of biological science; and, on the other hand, that the early biologists did not much concern themselves [353] with medicine. There is nothing to show that the Asclepiads took any prominent share in the work of founding anatomy, physiology, zoology, and botany. Rather do these seem to have sprung from the early philosophers, who were essentially natural philosophers, animated by the characteristically Greek thirst for knowledge as such. Pythagoras, Alcmeon, Democritus, Diogenes of Apollonia, are all credited with anatomical and physiological investigations; and, though Aristotle is said to have belonged to an Asclepiad family, and not improbably owed his taste for anatomical and zoological inquiries to the teachings of his father, the physician Nicomachus, the "Historia Animalium," and the treatise "De Partibus Animalium," are as free from any allusion to medicine as if they had issued from a modern biological laboratory.

It may be added, that it is not easy to see in what way it could have benefited a physician of Alexander's time to know all that Aristotle knew on these subjects. His human anatomy was too rough to avail much in diagnosis; his physiology was too erroneous to supply data for pathological reasoning. But when the Alexandrian school, with Erasistratus and Herophilus at their head, turned to account the opportunities of studying human structure, afforded to them by the Ptolemies, the value of the large amount of accurate knowledge thus obtained to the surgeon [354] for his operations, and to the physician for his diagnosis of internal disorders, became obvious, and a connection was established between anatomy and medicine, which has ever become closer and closer. Since the revival of learning, surgery, medical diagnosis, and anatomy have gone hand in hand. Morgagni called his great work, "De sedibus et causis morbonum per anatomen indagatis," and not only showed the way to search out the localities and the causes of disease by anatomy, but himself travelled wonderfully far upon the road. Bichat, discriminating the grosser constituents of the organs and parts of the body, one from another, pointed out the direction which modern research must take; until, at length, histology, a science of yesterday, as it seems to many of us, has carried the work of Morgagni as far as the microscope can take us, and has extended the realm of pathological anatomy to the limits of the invisible world.

Thanks to the intimate alliance of morphology with medicine, the natural history of disease has, at the present day, attained a high degree of perfection. Accurate regional anatomy has rendered practicable the exploration of the most hidden parts of the organism, and the determination, during life, of morbid changes in them; anatomical and histological post-mortem investigations have supplied physicians with a clear basis upon which to rest the classification of [355] diseases, and with unerring tests of the accuracy or inaccuracy of their diagnoses.

If men could be satisfied with pure knowledge, the extreme precision with which, in these days, a sufferer may be told what is happening, and what is likely to happen, even in the most recondite parts of his bodily frame, should be as satisfactory to the patient as it is to the scientific pathologist who gives him the information. But I am afraid it is not; and even the practising physician, while nowise under-estimating the regulative value of accurate diagnosis, must often lament that so much of his knowledge rather prevents him from doing wrong than helps him to do right.

A scorner of physic once said that nature and disease may be compared to two men fighting, the doctor to a blind man with a club, who strikes into the *mélée*, sometimes hitting the disease, and sometimes hitting nature. The matter is not mended if you suppose the blind man's hearing to be so acute that he can register every stage of the struggle, and pretty clearly predict how it will end. He had better not meddle at all, until his eyes are opened, until he can see the exact position of the antagonists, and make sure of the effect of his blows. But that which it behoves the physician to see, not, indeed, with his bodily eye, but with clear, intellectual vision, is a process, and the chain of causation involved in that process. Disease, as we [356] have seen, is a perturbation of the normal activities of a living body, and it is, and must remain, unintelligible, so long as we are ignorant of the nature of these normal activities. In other words, there could be no real science of pathology until the science of physiology had reached a degree of perfection unattained, and indeed unattainable, until quite recent times.

So far as medicine is concerned, I am not sure that physiology, such as it was down to the time of Harvey, might as well not have existed. Nay, it is perhaps no exaggeration to say that, within the memory of living men, justly renowned practitioners of medicine and surgery knew less physiology than is now to be learned from the most elementary text-book; and, beyond a few broad facts, regarded what they did know as of extremely little practical importance. Nor am I disposed to blame them for this conclusion; physiology must be useless, or worse than useless, to pathology, so long as its fundamental conceptions are erroneous.

Harvey is often said to be the founder of modern physiology; and there can be no question that the elucidations of the function of the heart, of the nature of the pulse, and of the course of the blood, put forth in the ever-memorable little essay, "De motu cordis," directly worked a revolution in men's views of the nature and of the concatenation of some of the most important [357] physiological processes among the higher animals; while, indirectly, their influence was perhaps even more remarkable.

But, though Harvey made this signal and perennially important contribution to the physiology of the moderns, his general conception of vital processes was essentially identical with that of the ancients; and, in the "Exercitationes de generatione," and notably in the singular chapter"De calido innato," he shows himself a true son of Galen and of Aristotle.

For Harvey, the blood possesses powers superior to those of the elements; it is the seat of a soul which is not only vegetative, but also sensitive and motor. The blood maintains and fashions all parts of the body, "idque summâ cum providentiâ et intellectu in finem certum agens, quasi ratiocinio quodam uteretur."

Here is the doctrine of the "pneuma," the product of the philosophical mould into which the animism of primitive men ran in Greece, in full force. Nor did its strength abate for long after Harvey's time. The same ingrained tendency of the human mind to suppose that a process is explained when it is ascribed to a power of which nothing is known except that it is the hypothetical agent of the process, gave rise, in the next century, to the animism of Stahl; and, later, to the doctrine of a vital principle, that "asylum ignorantiæ" of physiologists, which has so easily accounted for [358] everything and explained nothing, down to our own times.

Now the essence of modern, as contrasted with ancient, physiological science appears to me to lie in its antagonism to animistic hypotheses and animistic phraseology. It offers physical explanations of vital phenomena, or frankly confesses that it has none to offer. And, so far as I know, the first person who gave expression to this modern view of physiology, who was bold enough to enunciate the proposition that vital phenomena, like all the other phenomena of the physical world, are, in ultimate analysis, resolvable into matter and motion, was René Descartes.

The fifty-four years of life of this most original and powerful thinker are widely overlapped, on both sides, by the eighty of Harvey, who survived his younger contemporary by seven years, and takes pleasure in acknowledging the French philosopher's appreciation of his great discovery.

In fact, Descartes accepted the doctrine of the circulation as propounded by "Harvæus médecin d'Angleterre," and gave a full account of it in his first work, the famous "Discours de la Méthode," which was published in 1637, only nine years after the exercitation "De motu cordis"; and, though differing from Harvey on some important points (in which it may be noted, in passing, Descartes was wrong and Harvey right), he always speaks of him with great respect. And so impor[359]tant does the subject seem to Descartes, that he returns to it in the "Traité des Passions," and in the "Traité de l'Homme."

It is easy to see that Harvey's work must have had a peculiar significance for the subtle thinker, to whom we owe both the spiritualistic and the materialistic philosophies of modern times. It was in the very year of its publication, 1628, that Descartes withdrew into that life of solitary investigation and meditation of which his philosophy was the fruit. And, as the course of his speculations led him to establish an absolute distinction of nature between the material and the mental worlds, he was logically compelled to seek for the explanation of the phenomena of the material world within itself; and having allotted the realm of thought to the soul, to see nothing but extension and motion in the rest of nature. Descartes uses "thought" as the equivalent of our modern term "consciousness." Thought is the function of the soul, and its only function. Our natural heat and all the movements of the body, says he, do not depend on the soul. Death does not take place from any fault of the soul, but only because some of the principal parts of the body become corrupted. The body of a living man differs from that of a dead man in the same way as a watch or other automaton (that is to say, a machine which moves of itself) when it is wound up and has, in itself, the physical principle of the [360] movements which the mechanism is adapted to perform, differs from the same watch, or other machine, when it is broken, and the physical principle of its movement no longer exists. All the actions which are common to us and the lower animals depend

only on the conformation of our organs, and the course which the animal spirits take in the brain, the nerves, and the muscles; in the same way as the movement of a watch is produced by nothing but the force of its spring and the figure of its wheels and other parts.

Descartes' "Treatise on Man" is a sketch of human physiology, in which a bold attempt is made to explain all the phenomena of life, except those of consciousness, by physical reasonings. To a mind turned in this direction, Harvey's exposition of the heart and vessels as a hydraulic mechanism must have been supremely welcome.

Descartes was not a mere philosophical theorist, but a hardworking dissector and experimenter, and he held the strongest opinion respecting the practical value of the new conception which he was introducing. He speaks of the importance of preserving health, and of the dependence of the mind on the body being so close that, perhaps, the only way of making men wiser and better than they are, is to be sought in medical science. "It is true," says he, "that as medicine is now practised it contains little that is very useful; but without any desire to depreciate, I am sure that there is [361] no one, even among professional men, who will not declare that all we know is very little as compared with that which remains to be known; and that we might escape an infinity of diseases of the mind, no less than of the body, and even perhaps from the weakness of old age, if we had sufficient knowledge of their causes, and of all the remedies with which nature has provided us."[1] So strongly impressed was Descartes with this, that he resolved to spend the rest of his life in trying to acquire such a knowledge of nature as would lead to the construction of a better medical doctrine.[2] The anti-Cartesians found material for cheap ridicule in these aspirations of the philosopher; and it is almost needless to say that, in the thirteen years which elapsed between the publication of the "Discours" and the death of Descartes, he did not contribute much to their realisation. But, for the next century, all progress in physiology took place along the lines which Descartes laid down.

The greatest physiological and pathological work of the seventeenth century, Borelli's treatise "De Motu Animalium," is, to all intents and purposes, a development of Descartes' fundamental conception; and the same may be said of the physiology and pathology of Boerhaave, whose authority dominated in the medical world of the first half of the eighteenth century.

[362] With the origin of modern chemistry, and of electrical science, in the latter half of the eighteenth century, aids in the analysis of the phenomena of life, of which Descartes could not have dreamed, were offered to the physiologist. And the greater part of the gigantic progress which has been made in the present century is a justification of the prevision of Descartes. For it consists, essentially, in a more and more complete resolution of the grosser organs of the living body into physico-chemical mechanisms.

"I shall try to explain our whole bodily machinery in such a way, that it will be no more necessary for us to suppose that the soul produces such movements as are not voluntary, than it is to think that there is in a clock a soul which causes it to show the hours."[3] These words of Descartes might be appropriately taken as a motto by the author of any modern treatise on physiology.

But though, as I think, there is no doubt that Descartes was the first to propound the fundamental conception of the living body as a physical mechanism, which is the distinctive feature of modern, as contrasted with ancient physiology, he was misled by the natural temptation to carry out, in all its details, a parallel between the machines with which he was familiar, such as clocks and pieces of hydraulic apparatus, and the living machine. In all such machines there is a [363] central source of power, and the parts of the machine are merely passive distributors of that power. The Cartesian school conceived of the living body as a machine of this kind; and herein they might have learned from Galen, who, whatever ill use he may have made of the doctrine of "natural faculties," nevertheless had the great merit of perceiving that local forces play a great part in physiology.

The same truth was recognised by Glisson, but it was first prominently brought forward in the Hallerian doctrine of the "vis insita" of muscles. If muscle can contract without nerve, there is an end of the Cartesian mechanical explanation of its contraction by the influx of animal spirits.

The discoveries of Trembley tended in the same direction. In the freshwater *Hydra*, no trace was to be found of that complicated machinery upon which the performance of the functions in the higher animals was supposed to depend. And yet the hydra moved, fed, grew, multiplied, and its fragments exhibited all the powers of the whole. And, finally, the work of Caspar F. Wolff,[4] by demonstrating the fact that the growth and development of both plants and animals take place antecedently to the existence of their grosser organs, and are, in fact, the causes and not the consequences of organisation (as then understood), sapped the foundations of the [364] Cartesian physiology as a complete expression of vital phenomena.

For Wolff, the physical basis of life is a fluid, possessed of a "vis essentialis" and a "solidescibilitas" in virtue of which it gives rise to organisation; and, as he points out, this conclusion strikes at the root of the whole iatro-mechanical system.

In this country, the great authority of John Hunter exerted a similar influence; though it must be admitted that the too sibylline utterances which are the outcome of Hunter's struggles to define his conceptions are often susceptible of more than one interpretation. Nevertheless, on some points Hunter is clear enough. For example, he is of opinion that "Spirit is only a property of matter" ("Introduction to Natural History," p. 6), he is prepared to renounce animism, (*l.c.* p. 8), and his conception of life is so completely physical that he thinks of it as something which can exist in a state of combination in the food. "The aliment we take in has in it, in a fixed state, the real life; and this does not become active until it has got into the lungs; for there it is freed from its prison" ("Observations on Physiology," p. 113). He also thinks that "It is more in accord with the general principles of the animal machine to suppose that none of its effects are produced from any mechanical principle whatever; and that every effect is produced from [365] an action in the part; which action is produced by a stimulus upon the part which acts, or upon some other part with which this part sympathises so as to take up the whole action" (*l.c.* p. 152).

And Hunter is as clear as Wolff, with whose work he was probably unacquainted, that "whatever life is,

it most certainly does not depend upon structure or organisation" (*l.c.* p. 114).

Of course it is impossible that Hunter could have intended to deny the existence of purely mechanical operations in the animal body. But while, with Borelli and Boerhaave, he looked upon absorption, nutrition, and secretion as operations effected by means of the small vessels, he differed from the mechanical physiologists, who regarded these operations as the result of the mechanical properties of the small vessels, such as the size, form, and disposition of their canals and apertures. Hunter, on the contrary, considers them to be the effect of properties of these vessels which are not mechanical but vital. "The vessels," says he, "have more of the polypus in them than any other part of the body," and he talks of the "living and sensitive principles of the arteries," and even of the "dispositions or feelings of the arteries." "When the blood is good and genuine the sensations of the arteries, or the dispositions for sensation, are agreeable.... It is then they dispose of the blood to the best advantage, increasing the growth of the whole, [366] supplying any losses, keeping up a due succession, etc." (*l.c.* p. 133).

If we follow Hunter's conceptions to their logical issue, the life of one of the higher animals is essentially the sum of the lives of all the vessels, each of which is a sort of physiological unit, answering to a polype; and, as health is the result of the normal "action of the vessels," so is disease an effect of their abnormal action. Hunter thus stands in thought, as in time, midway between Borelli on the one hand, and Bichat on the other.

The acute founder of general anatomy, in fact, outdoes Hunter in his desire to exclude physical reasonings from the realm of life. Except in the interpretation of the action of the sense organs, he will not allow physics to have anything to do with physiology.

"To apply the physical sciences to physiology is to explain the phenomena of living bodies by the laws of inert bodies. Now this is a false principle, hence all its consequences are marked with the same stamp. Let us leave to chemistry its affinity; to physics, its elasticity and its gravity. Let us invoke for physiology only sensibility and contractility."[5]

Of all the unfortunate dicta of men of eminent ability this seems one of the most unhappy, when we think of what the application of the methods and the data of physics and chemistry has done [367] towards bringing physiology into its present state. It is not too much to say that one-half of a modern text-book of physiology consists of applied physics and chemistry; and that it is exactly in the exploration of the phenomena of sensibility and contractility that physics and chemistry have exerted the most potent influence.

Nevertheless, Bichat rendered a solid service to physiological progress by insisting upon the fact that what we call life, in one of the higher animals, is not an indivisible unitary archæus dominating, from its central seat, the parts of the organism, but a compound result of the synthesis of the separate lives of those parts.

"All animals," says he, "are assemblages of different organs, each of which performs its function and

concurs, after its fashion, in the preservation of the whole. They are so many special machines in the general machine which constitutes the individual. But each of these special machines is itself compounded of many tissues of very different natures, which in truth constitute the elements of those organs" (*l.c.* lxxix.). "The conception of a proper vitality is applicable only to these simple tissues, and not to the organs themselves" (*l.c.* lxxxiv.).

And Bichat proceeds to make the obvious application of this doctrine of synthetic life, if I may so call it, to pathology. Since diseases are only alterations of vital properties, and the [368] properties of each tissue are distinct from those of the rest, it is evident that the diseases of each tissue must be different from those of the rest. Therefore, in any organ composed of different tissues, one may be diseased and the other remain healthy; and this is what happens in most cases (*l.c.* lxxxv.).

In a spirit of true prophecy, Bichat says, "We have arrived at an epoch in which pathological anatomy should start afresh." For, as the analysis of the organs had led him to the tissues as the physiological units of the organism; so, in a succeeding generation, the analysis of the tissues led to the cell as the physiological element of the tissues. The contemporaneous study of development brought out the same result; and the zoologists and botanists, exploring the simplest and the lowest forms of animated beings, confirmed the great induction of the cell theory. Thus the apparently opposed views, which have been battling with one another ever since the middle of the last century, have proved to be each half the truth.

The proposition of Descartes that the body of a living man is a machine, the actions of which are explicable by the known laws of matter and motion, is unquestionably largely true. But it is also true, that the living body is a synthesis of innumerable physiological elements, each of which may nearly be described, in Wolff's words, as a [369] fluid possessed of a "vis essentialis" and a "solidescibilitas"; or, in modern phrase, as protoplasm susceptible of structural metamorphosis and functional metabolism: and that the only machinery, in the precise sense in which the Cartesian school understood mechanism, is, that which co-ordinates and regulates these physiological units into an organic whole.

In fact, the body is a machine of the nature of an army, not of that of a watch or of a hydraulic apparatus. Of this army each cell is a soldier, an organ a brigade, the central nervous system headquarters and field telegraph, the alimentary and circulatory system the commissariat. Losses are made good by recruits born in camp, and the life of the individual is a campaign, conducted successfully for a number of years, but with certain defeat in the long run.

The efficacy of an army, at any given moment, depends on the health of the individual soldier, and on the perfection of the machinery by which he is led and brought into action at the proper time; and, therefore, if the analogy holds good, there can be only two kinds of diseases, the one dependent on abnormal states of the physiological units, the other on perturbations of their co-ordinating and alimentative machinery.

Hence, the establishment of the cell theory, in normal biology, was swiftly followed by a "cellular pathology," as its logical counterpart. I need not remind you how great an instrument of investiga[370]

tion this doctrine has proved in the hands of the man of genius to whom its development is due, and who would probably be the last to forget that abnormal conditions of the co-ordinative and distributive machinery of the body are no less important factors of disease.

Henceforward, as it appears to me, the connection of medicine with the biological sciences is clearly indicated. Pure pathology is that branch of biology which defines the particular perturbation of cell-life, or of the co-ordinating machinery, or of both, on which the phenomena of disease depend.

Those who are conversant with the present state of biology will hardly hesitate to admit that the conception of the life of one of the higher animals as the summation of the lives of a cell aggregate, brought into harmonious action by a co-ordinative machinery formed by some of these cells, constitutes a permanent acquisition of physiological science. But the last form of the battle between the animistic and the physical views of life is seen in the contention whether the physical analysis of vital phenomena can be carried beyond this point or not.

There are some to whom living protoplasm is a substance, even such as Harvey conceived the blood to be, "summâ cum providentiâ et intellectu in finem certum agens, quasi ratiocinio quodam;" and who look with as little favour as Bichat did, upon any attempt to apply the principles and the methods of physics and chemistry to the [371] investigation of the vital processes of growth, metabolism, and contractility. They stand upon the ancient ways; only, in accordance with that progress towards democracy, which a great political writer has declared to be the fatal characteristic of modern times, they substitute a republic formed by a few billion of "animulæ" for the monarchy of the all-pervading "anima."

Others, on the contrary, supported by a robust faith in the universal applicability of the principles laid down by Descartes, and seeing that the actions called "vital" are, so far as we have any means of knowing, nothing but changes of place of particles of matter, look to molecular physics to achieve the analysis of the living protoplasm itself into a molecular mechanism. If there is any truth in the received doctrines of physics, that contrast between living and inert matter, on which Bichat lays so much stress, does not exist. In nature, nothing is at rest, nothing is amorphous; the simplest particle of that which men in their blindness are pleased to call "brute matter" is a vast aggregate of molecular mechanisms performing complicated movements of immense rapidity, and sensitively adjusting themselves to every change in the surrounding world. Living matter differs from other matter in degree and not in kind; the microcosm repeats the macrocosm; and one chain of causation connects the nebulous original of suns and planetary systems with the protoplasmic foundation of life and organisation.

[372] From this point of view, pathology is the analogue of the theory of perturbations in astronomy; and therapeutics resolves itself into the discovery of the means by which a system of forces competent to eliminate any given perturbation may be introduced into the economy. And, as pathology bases itself upon normal physiology, so therapeutics rests upon pharmacology; which is, strictly speaking, a part of the great biological topic of the influence of conditions on the living organism, and has no scientific foundation apart from physiology.

It appears to me that there is no more hopeful indication of the progress of medicine towards the ideal of Descartes than is to be derived from a comparison of the state of pharmacology, at the present day, with that which existed forty years ago. If we consider the knowledge positively acquired, in this short time, of the *modus operandi*. of urari, of atropia, of physostigmin, of veratria, of casca, of strychnia, of bromide of potassium, of phosphorus, there can surely be no ground for doubting that, sooner or later, the pharmacologist will supply the physician with the means of affecting, in any desired sense, the functions of any physiological element of the body. It will, in short, become possible to introduce into the economy a molecular mechanism which, like a very cunningly-contrived torpedo, shall find its way to some particular group of living elements, and cause an explosion among them, leaving the rest untouched.

[373] The search for the explanation of diseased states in modified cell-life; the discovery of the important part played by parasitic organisms in the ætiology of disease; the elucidation of the action of medicaments by the methods and the data of experimental physiology; appear to me to be the greatest steps which have ever been made towards the establishment of medicine on a scientific basis. I need hardly say they could not have been made except for the advance of normal biology.

There can be no question, then, as to the nature or the value of the connection between medicine and the biological sciences. There can be no doubt that the future of pathology and of therapeutics, and, therefore, that of practical medicine, depends upon the extent to which those who occupy themselves with these subjects are trained in the methods and impregnated with the fundamental truths of biology.

And, in conclusion, I venture to suggest that the collective sagacity of this congress could occupy itself with no more important question than with this: How is medical education to be arranged, so that, without entangling the student in those details of the systematist which are valueless to him, he may be enabled to obtain a firm grasp of the great truths respecting animal and vegetable life, without which, notwithstanding all the progress of scientific medicine, he will still find himself an empiric?

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[1] *Discours de la Méthode*, 6e partie, Ed.Cousin, p. 193.

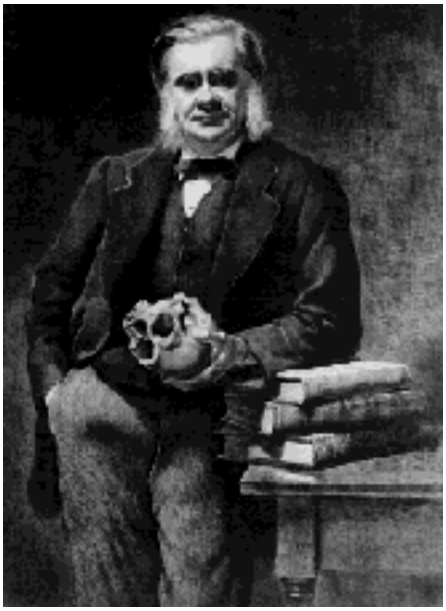
[2] *Ibid.* pp. 193 and 211.

[3] *De la Formation du Fœtus.*

[4] *Theoria Generationis*, 1759.

[5] *Anatomie générale*, i, p. 1iv.

THE HUXLEY FILE



Preface and Table of Contents to Volume III, *Science & Education*, of Huxley's *Collected Essays*.

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C. Blinderman & D. Joyce
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Technical Education (1877)

Collected Essays III

[404] Any candid observer of the phenomena of modern society will readily admit that bores must be classed among the enemies of the human race and a little consideration will probably lead him to the further admission, that no species of that extensive genus of noxious creatures is more objectionable than the educational bore. Convinced as I am of the truth of this great social generalisation, it is not without a certain trepidation that I venture to address you on an educational topic. For, in the course of the last ten years, to go back no farther, I am afraid to say how often I have ventured to speak of education, from that given in the primary schools to that which is to be had in the universities and medical colleges; indeed, the only part of this wide region into which, as yet, I have not adventured is that into which I propose to intrude to-day.

[405] Thus, I cannot but be aware that I am dangerously near becoming the thing which all men fear and fly. But I have deliberately elected to run the risk. For when you did me the honour to ask me to address you, an unexpected circumstance had led me to occupy myself seriously with the question of technical education; and I had acquired the conviction that there are few subjects respecting which it is more important for all classes of the community to have clear and just ideas than this; while, certainly, there is none which is more deserving of attention by the Working Men's Club and Institute Union.

It is not for me to express an opinion whether the considerations, which I am about to submit to you, will be proved by experience to be just or not, but I will do my best to make them clear. Among the many good things to be found in Lord Bacon's works, none is more full of wisdom than the saying that "truth more easily comes out of error than out of confusion." Clear and consecutive wrong-thinking is the next best thing to right-thinking; so that, if I succeed in clearing your ideas on this topic, I shall have wasted neither your time nor my own.

"Technical education," in the sense in which the term is ordinarily used, and in which I am now employing it, means that sort of education which is specially adapted to the needs of men whose business in life it is to pursue some kind of handi[406]craft; it is, in fact, a fine Greco-Latin equivalent for what in good vernacular English would be called "the teaching of handicrafts." And probably, at this stage of our progress, it may occur to many of you to think of the story of the cobbler and his last, and to say to yourselves, though you will be too polite to put the question openly to me, What does the speaker know practically about this matter? What is his handicraft? I think the question is a very proper one, and unless I were prepared to answer it, I hope satisfactorily, I should have chosen some other theme.

The fact is, I am, and have been, any time these thirty years, a man who works with his hands–a handicraftsman. I do not say this in the broadly metaphorical sense in which fine gentlemen, with all the delicacy of Agag about them, trip to the hustings about election time, and protest that they too are working men. I really mean my words to be taken in their direct, literal, and straightforward sense. In

fact, if the most nimble-fingered watchmaker among you will come to my workshop, he may set me to put a watch together, and I will set him to dissect, say, a blackbeetle's nerves. I do not wish to vaunt, but I am inclined to think that I shall manage my job to his satisfaction sooner than he will do his piece of work to mine.

In truth, anatomy, which is my handicraft, is one of the most difficult kinds of mechanical labour involving, as it does, not only lightness and dex[407]terity of hand, but sharp eyes and endless patience. And you must not suppose that my particular branch of science is especially distinguished for the demand it makes upon skill in manipulation. A similar requirement is made upon all students of physical science. The astronomer, the electrician, the chemist, the mineralogist, the botanist, are constantly called upon to perform manual operations of exceeding delicacy. The progress of all branches of physical science depends upon observation, or on that artificial observation which is termed experiment, of one kind or another; and, the farther we advance, the more practical difficulties surround the investigation of the conditions of the problems offered to us; so that mobile and yet steady hands, guided by clear vision, are more and more in request in the workshops of science.

Indeed, it has struck me that one of the grounds of that sympathy between the handicraftsmen of this country and the men of science, by which it has so often been my good fortune to profit, may, perhaps, lie here. You feel and we feel that, among the so-called learned folks, we alone are brought into contact with tangible facts in the way that you are. You know well enough that it is one thing to write a history of chairs in general, or to address a poem to a throne, or to speculate about the occult powers of the chair of St. Peter; and quite another thing to make with your own hands a veritable chair, that will stand fair and square, [408] and afford a safe and satisfactory resting-place to a frame of sensitiveness and solidity.

So it is with us, when we look out from our scientific handicrafts upon the doings of our learned brethren, whose work is untrammelled by anything "base and mechanical," as handicrafts used to be called when the world was younger, and, in some respects, less wise than now. We take the greatest interest in their pursuits; we are edified by their histories and are charmed with their poems, which sometimes illustrate so remarkably the powers of man's imagination; some of us admire and even humbly try to follow them in their high philosophical excursions, though we know the risk of being snubbed by the inquiry whether grovelling dissectors of monkeys and blackbeetles can hope to enter into the empyreal kingdom of speculation. But still we feel that our business is different; humbler if you will, though the diminution of dignity is, perhaps, compensated by the increase of reality; and that we, like you, have to get our work done in a region where little avails, if the power of dealing with practical tangible facts is wanting. You know that clever talk touching joinery will not make a chair; and I know that it is of about as much value in the physical sciences. Mother Nature is serenely obdurate to honeyed words; only those who understand the ways of things, and can silently and effectually handle them, get any good out of her.

[409] And now, having, as I hope, justified my assumption of a place among handicraftsmen, and put myself right with you as to my qualification, from practical knowledge, to speak about technical education, I will proceed to lay before you the results of my experience as a teacher of a handicraft, and tell you what sort of education I should think best adapted for a boy whom one wanted to make a

professional anatomist.

I should say, in the first place, let him have a good English elementary education. I do not mean that he shall be able to pass in such and such a standard–that may or may not be an equivalent expression–but that his teaching shall have been such as to have given him command of the common implements of learning and to have created a desire for the things of the understanding.

Further, I should like him to know the elements of physical science, and especially of physics and chemistry, and I should take care that this elementary knowledge was real. I should like my aspirant to be able to read a scientific treatise in Latin, French, or German, because an enormous amount of anatomical knowledge is locked up in those languages. And especially, I should require some ability to draw–I do not mean artistically, for that is a gift which may be cultivated but cannot be learned, but with fair accuracy. I will not say that everybody can learn even this; for the [410] negative development of the faculty of drawing in some people is almost miraculous. Still everybody, or almost everybody, can learn to write; and, as writing is a kind of drawing, I suppose that the majority of the people who say they cannot draw, and give copious evidence of the accuracy of their assertion, could draw, after a fashion, if they tried. And that "after a fashion" would be better than nothing for my purposes.

Above all things, let my imaginary pupil have preserved the freshness and vigour of youth in his mind as well as his body. The educational abomination of desolation of the present day is the stimulation of young people to work at high pressure by incessant competitive examinations. Some wise man (who probably was not an early riser) has said of early risers in general, that they are conceited all the forenoon and stupid all the afternoon. Now whether this is true of early risers in the common acceptation of the word or not, I will not pretend to say; but it is too often true of the unhappy children who are forced to rise too early in their classes. They are conceited all the forenoon of life, and stupid all its afternoon. The vigour and freshness, which should have been stored up for the purposes of the hard struggle for existence in practical life, have been washed out of them by precocious mental debauchery–by book gluttony and lesson bibbing. Their faculties are worn out by the strain put upon their [411] callow brains, and they are demoralised by worthless childish triumphs before the real work of life begins. I have no compassion for sloth, but youth has more need for intellectual rest than age; and the cheerfulness, the tenacity of purpose, the power of work which make many a successful man what he is, must often be placed to the credit, not of his hours of industry, but to that of his hours of idleness, in boyhood. Even the hardest worker of us all, if he has to deal with anything above mere details, will do well, now and again, to let his brain lie fallow for a space. The next crop of thought will certainly be all the fuller in the ear and the weeds fewer.

This is the sort of education which I should like any one who was going to devote himself to my handicraft to undergo. As to knowing anything about anatomy itself, on the whole I would rather he left that alone until he took it up seriously in my laboratory. It is hard work enough to teach, and I should not like to have superadded to that the possible need of unteaching.

Well, but, you will say, this is Hamlet with the Prince of Denmark left out; your "technical education" is

simply a good education, with more attention to physical science, to drawing, and to modern languages than is common, and there is nothing specially technical about it.

[412] Exactly so; that remark takes us straight to the heart of what I have to say; which is, that, in my judgment, the preparatory education of the handicraftsman ought to have nothing of what is ordinarily understood by "technical" about it.

The workshop is the only real school for a handicraft. The education which precedes that of the workshop should be entirely devoted to the strengthening of the body, the elevation of the moral faculties, and the cultivation of the intelligence; and, especially, to the imbuing the mind with a broad and clear view of the laws of that natural world with the components of which the handicraftsman will have to deal. And, the earlier the period of life at which the handicraftsman has to enter into actual practice of his craft, the more important is it that he should devote the precious hours of preliminary education to things of the mind, which have no direct and immediate bearing on his branch of industry, though they lie at the foundation of all realities.

Now let me apply the lessons I have learned from my handicraft to yours. If any of you were obliged to take an apprentice, I suppose you would like to get a good healthy lad, ready and willing to learn, handy, and with his fingers not all thumbs, as the saying goes. You would like that he should read, write, and cipher well; and, [413] if you were an intelligent master, and your trade involved the application of scientific principles, as so many trades do, you would like him to know enough of the elementary principles of science to understand what was going on. I suppose that, in nine trades out of ten, it would be useful if he could draw; and many of you must have lamented your inability to find out for yourselves what foreigners are doing or have done. So that some knowledge of French and German might, in many cases, be very desirable.

So it appears to me that what you want is pretty much what I want; and the practical question is, How you are to get what you need, under the actual limitations and conditions of life of handicraftsmen in this country?

I think I shall have the assent both of the employers of labour and of the employed as to one of these limitations; which is, that no scheme of technical education is likely to be seriously entertained which will delay the entrance of boys into working life, or prevent them from contributing towards their own support, as early as they do at present. Not only do I believe that any such scheme could not be carried out, but I doubt its desirableness, even if it were practicable.

The period between childhood and manhood is full of difficulties and dangers, under the most favourable circumstances; and, even among the well-to-do, who can afford to surround their children [414] with the most favourable conditions, examples of a career ruined, before it has well begun, are but too frequent. Moreover, those who have to live by labour must be shaped to labour early. The colt that is left at grass too long makes but a sorry draught-horse, though his way of life does not bring him within the reach of artificial temptations. Perhaps the most valuable result of all education is the ability to make

yourself do the thing you have to do, when it ought to be done, whether you like it or not; it is the first lesson that ought to be learned; and, however early a man's training begins, it is probably the last lesson that he learns thoroughly.

There is another reason, to which I have already adverted, and which I would reiterate, why any extension of the time devoted to ordinary schoolwork is undesirable. In the newly-awakened zeal for education, we run some risk of forgetting the truth that while under-instruction is a bad thing, overinstruction may possibly be a worse.

Success in any kind of practical life is not dependent solely, or indeed chiefly, upon knowledge. Even in the learned professions, knowledge alone, is of less consequence than people are apt to suppose. And if much expenditure of bodily energy is involved in the day's work, mere knowledge is of still less importance when weighed against the probable cost of its acquirement. To do a fair day's work with his hands, a man needs, above all things, health, strength, and the patience and cheer[415]fulness which, if they do not always accompany these blessings, can hardly in the nature of things exist without them; to which we must add honesty of purpose and a pride in doing what is done well.

A good handicraftsman can get on very well without genius, but he will fare badly without a reasonable share of that which is a more useful possession for workaday life, namely, mother-wit; and he will be all the better for a real knowledge, however limited, of the ordinary laws of nature, and especially of those which apply to his own business.

Instruction carried so far as to help the scholar to turn his store of mother-wit to account, to acquire a fair amount of sound elementary knowledge, and to use his hands and eyes; while leaving him fresh, vigorous, and with a sense of the dignity of his own calling, whatever it may be, if fairly and honestly pursued, cannot fail to be of invaluable service to all those who come under its influence.

But, on the other hand, if school instruction is carried so far as to encourage bookishness; if the ambition of the scholar is directed, not to the gaining of knowledge, but to the being able to pass examinations successfully; especially if encouragement is given to the mischievous delusion that brainwork is, in itself, and apart from its quality, a nobler or more respectable thing than handiwork [416]–such education may be a deadly mischief to the workman, and lead to the rapid ruin of the industries it is intended to serve.

I know that I am expressing the opinion of some of the largest as well as the most enlightened employers of labour, when I say that there is a real danger that, from the extreme of no education, we may run to the other extreme of over-education of handicraftsmen. And I apprehend that what is true for the ordinary hand-worker is true for the foreman. Activity, probity, knowledge of men, ready mother-wit, supplemented by a good knowledge of the general principles involved in his business, are the making of a good foreman. If he possess these qualities, no amount of learning will fit him better for his position; while the course of life and the habit of mind required for the attainment of such learning may, in various direct and indirect ways, act as direct disqualifications for it.

Keeping in mind, then, that the two things to be avoided are, the delay of the entrance of boys into practical life, and the substitution of exhausted bookworms for shrewd, handy men, in our works and factories, let us consider what may be wisely and safely attempted in the way of improving the education of the handicraftsman.

First, I look to the elementary schools now happily established all over the country. I am not going to criticise or find fault with them; on the [417] contrary, their establishment seems to me to be the most important and the most beneficial result of the corporate action of the people in our day. A great deal is said of British interests just now, but, depend upon it, that no Eastern difficulty needs our intervention as a nation so seriously, as the putting down both the Bashi-Bazouks of ignorance and the Cossacks of sectarianism at home. What has already been achieved in these directions is a great thing; you must have lived some time to know how great. An education, better in its processes, better in its substance, than that which was accessible to the great majority of well-to-do Britons a quarter of a century ago, is now obtainable by every child in the land. Let any man of my age go into an ordinary elementary school, and unless he was unusually fortunate in his youth, he will tell you that the educational method, the intelligence, patience, and good temper on the teacher's part, which are now at the disposal of the veriest waifs and wastrels of society, are things of which he had no experience in those costly, middle-class schools, which were so ingeniously contrived as to combine all the evils and shortcomings of the great public schools with none of their advantages. Many a man, whose so-called education cost a good deal of valuable money and occupied many a year of invaluable time, leaves the inspection of a well-ordered elementary school devoutly wishing that, in his young days, he had [418] had the chance of being as well taught as these boys and girls are.

But while in view of such an advance in general education, I willingly obey the natural impulse to be thankful, I am not willing altogether to rest. I want to see instruction in elementary science and in art more thoroughly incorporated in the educational system. At present, it is being administered by driblets, as if it were a potent medicine, "a few drops to be taken occasionally in a teaspoon." Every year I notice that that earnest and untiring friend of yours and of mine, Sir John Lubbock, stirs up the Government of the day in the House of Commons on this subject; and also that, every year, he, and the few members of the House of Commons, such as Dr. Playfair, who sympathise with him, are met with expressions of warm admiration for science in general, and reasons at large for doing nothing in particular. But now that Mr. Forster, to whom the education of the country owes so much, has announced his conversion to the right faith, I begin to hope that, sooner or later, things will mend.

I have given what I believe to be a good reason for the assumption, that the keeping at school of boys, who are to be handicraftsmen, beyond the age of thirteen or fourteen is neither practicable nor desirable; and, as it is quite certain that, with justice to other and no less import[419]ant branches of education, nothing more than the rudiments of science and art teaching can be introduced into elementary schools, we must seek elsewhere for a supplementary training in these subjects, and, if need be, in foreign languages, which may go on after the workman's life has begun.

The means of acquiring the scientific and artistic part of this training already exists in full working

order, in the first place, in the classes of the Science and Art Department, which are, for the most part, held in the evening, so as to be accessible to all who choose to avail themselves of them after working hours. The great advantage of these classes is that they bring the means of instruction to the doors of the factories and workshops; that they are no artificial creations, but by their very existence prove the desire of the people for them; and finally, that they admit of indefinite development in proportion as they are wanted. I have often expressed the opinion, and I repeat it here, that, during the eighteen years they have been in existence these classes have done incalculable good; and I can say, of my own knowledge, that the Department spares no pains and trouble in trying to increase their usefulness and ensure the soundness of their work.

No one knows better than my friend Colonel Donnelly, to whose clear views and great administrative abilities so much of the successful working [420] of the science classes is due, that there is much to be done before the system can be said to be thoroughly satisfactory. The instruction given needs to be made more systematic and especially more practical; the teachers are of very unequal excellence, and not a few stand much in need of instruction themselves, not only in the subject which they teach, but in the objects for which they teach. I dare say you have heard of that proceeding, reprobated by all true sportsmen, which is called "shooting for the pot." Well, there is such a thing as "teaching for the pot"–teaching, that is, not that your scholar may know, but that he may count for payment among those who pass the examination; and there are some teachers, happily not many, who have yet to learn that the examiners of the Department regard them as poachers of the worst description.

Without presuming in any way to speak in the name of the Department, I think I may say, as a matter which has come under my own observation that it is doing its best to meet all these difficulties. It systematically promotes practical instruction in the classes; it affords facilities to teachers who desire to learn their business thoroughly; and it is always ready to aid in the suppression of pot-teaching.

All this is, as you may imagine, highly satisfactory to me. I see that spread of scientific education, about which I have so often permitted [421] myself to worry the public, become, for all practical purposes, an accomplished fact. Grateful as I am for all that is now being done, in the same direction, in our higher schools and universities, I have ceased to have any anxiety about the wealthier classes. Scientific knowledge is spreading by what the alchemists called a "distillatio per ascensum;" and nothing now can prevent it from continuing to distil upwards and permeate English society, until, in the remote future, there shall be no member of the legislature who does not know as much of science as an elementary school-boy; and even the heads of houses in our venerable seats of learning shall acknowledge that natural science is not merely a sort of University backdoor through which inferior men may get at their degrees. Perhaps this apocalyptic vision is a little wild; and I feel I ought to ask pardon for an outbreak of enthusiasm, which, I assure you, is not my commonest failing.

I have said that the Government is already doing a great deal in aid of that kind of technical education for handicraftsmen which, to my mind, is alone worth seeking. Perhaps it is doing as much as it ought to do, even in this direction. Certainly there is another kind of help of the most important character, for which we may look elsewhere than to the Government. The great mass of mankind have neither the liking, nor the aptitude, for either literary, or scientific, or artistic pursuits; nor, [422] indeed, for

excellence of any sort. Their ambition is to go through life with moderate exertion and a fair share of ease, doing common things in a common way. And a great blessing and comfort it is that the majority of men are of this mind; for the majority of things to be done are common things, and are quite well enough done when commonly done. The great end of life is not knowledge but action. What men need is, as much knowledge as they can assimilate and organise into a basis for action; give them more and it may become injurious. One knows people who are as heavy and stupid from undigested learning as others are from over-fulness of meat and drink. But a small percentage of the population is born with that most excellent quality, a desire for excellence, or with special aptitudes of some sort or another; Mr. Galton tells us that not more than one in four thousand may be expected to attain distinction, and not more than one in a million some share of that intensity of instinctive aptitude, that burning thirst for excellence, which is called genius.

Now, the most important object of all educational schemes is to catch these exceptional people, and turn them to account for the good of society. No man can say where they will crop up; like their opposites, the fools and knaves, they appear sometimes in the palace, and sometimes in the hovel; but the great thing to be aimed at, I was almost going to say the most important end of all [423] social arrangements, is to keep these glorious sports of Nature from being either corrupted by luxury or starved by poverty, and to put them into the position in which they can do the work for which they are especially fitted.

Thus, if a lad in an elementary school showed signs of special capacity, I would try to provide him with the means of continuing his education after his daily working life had begun; if in the evening classes he developed special capabilities in the direction of science or of drawing, I would try to secure him an apprenticeship to some trade in which those powers would have applicability. Or, if he chose to become a teacher, he should have the chance of so doing. Finally, to the lad of genius, the one in a million, I would make accessible the highest and most complete training the country could afford. Whatever that might cost, depend upon it the investment would be a good one. I weigh my words when I say that if the nation could purchase a potential Watt, or Davy, or Faraday, at the cost of a hundred thousand pounds down, he would be dirt-cheap at the money. It is a mere commonplace and everyday piece of knowledge, that what these three men did has produced untold millions of wealth, in the narrowest economical sense of the word.

Therefore, as the sum and crown of what is to be done for technical education, I look to the provision of a machinery for willowing out the capacities [424] and giving them scope. When I was a member of the London School Board, I said, in the course of a speech, that our business was to provide a ladder, reaching from the gutter to the university, along which every child in the three kingdoms should have the chance of climbing as far as he was fit to go. This phrase was so much bandied about at the time, that, to say truth, I am rather tired of it; but I know of no other which so fully expresses my belief, not only about education in general, but about technical education in particular.

The essential foundation of all the organisation needed for the promotion of education among handicraftsmen will, I believe, exist in this country, when every working lad can feel that society has done as much as lies in its power to remove all needless and artificial obstacles from his path; that there is no barrier, except such as exists in the nature of things, between himself and whatever place in the

social organisation he is fitted to fill; and, more than this, that, if he has capacity and industry, a hand is held out to help him along any path which is wisely and honestly chosen.

I have endeavoured to point out to you that a great deal of such an organisation already exists; and I am glad to be able to add that there is a good prospect that what is wanting will, before long, be supplemented.

[425] Those powerful and wealthy societies, the livery companies of the City of London, remembering that they are the heirs and representatives of the trade guilds of the Middle Ages, are interesting themselves in the question. So far back as 1872 the Society of Arts organised a system of instruction in the technology of arts and manufactures, for persons actually employed in factories and workshops, who desired to extend and improve their knowledge of the theory and practice of their particular avocations;[1] and a considerable subsidy, in aid of the efforts of the Society, was liberally granted by the Clothworkers' Company. We have here the hopeful commencement of a rational organisation for the promotion of excellence among handicraftsmen. Quite recently, other of the livery companies have determined upon giving their powerful, and, indeed, almost boundless, aid to the improvement of the teaching of handicrafts. They have already gone so far as to appoint a committee to act for them; and I betray no confidence in adding that, some time since, the committee sought the advice and assistance of several persons, myself among the number.

Of course I cannot tell you what may be the result of the deliberations of the committee; but we may all fairly hope that, before long, steps which will have a weighty and a lasting influence on the growth and [426] spread of sound and thorough teaching among the handicraftsmen[2] of this country will be taken by the livery companies of London.

[This hope has been fully justified by the establishment of the Cowper Street Schools, and that of the Central Institution of the City and Guilds of London Institute, September, 1881.]

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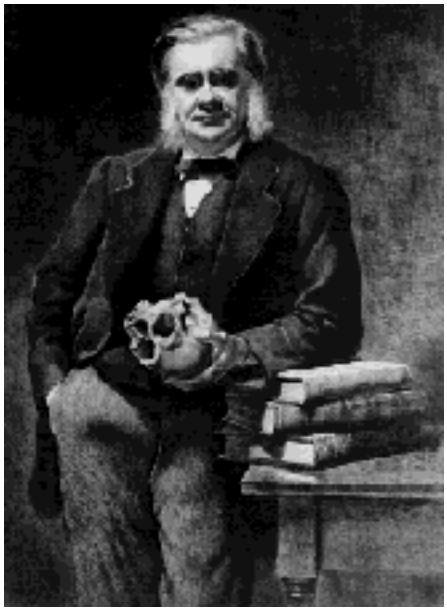
[1] See the *Programme* for 1878, issued by the Society of Arts, p. 14.

[2] It is perhaps advisable to remark that the important question of the professional education of managers of industrial works is not touched in the foregoing remarks.

THE HUXLEY FILE



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C. Blinderman & D. Joyce
Clark University

Address on Behalf of the National Association for the Promotion of Technical Education (1887)

Collected Essays III

[427] Mr. Mayor and Gentlemen,–It must be a matter of sincere satisfaction to those who, like myself, have for many years past been convinced of the vital importance of technical education to this country to see that that subject is now being taken up by some of the most important of our manufacturing towns. The evidence which is afforded of the public interest in the matter by such meetings as those at Liverpool and Newcastle, and, last but not least, by that at which I have the honour to be present to-day, may convince us all, I think, that the question has passed out of the region of speculation into that of action. I need hardly say to any one here that the task which our Association contemplates is not only [428] one of primary importance–I may say of vital importance–to the welfare of the country; but that it is one of great extent and of vast difficulty. There is a well-worn adage that those who set out upon a great enterprise would do well to count the cost. I am not sure that this is always true. I think that some of the very greatest enterprises in this world have been carried out successfully simply because the people who undertook them did not count the cost; and I am much of opinion that, in this very case, the most instructive consideration for us is the cost of doing nothing. But there is one thing that is perfectly certain, and it is that, in undertaking all enterprises, one of the most important conditions of success is to have a perfectly clear comprehension of what you want to do–to have that before your minds before you set out, and from that point of view to consider carefully the measures which are best adapted to the end.

Mr. Acland has just given you an excellent account of what is properly and strictly understood by technical education; but I venture to think that the purpose of this Association may be stated in somewhat broader terms, and that the object we have in view is the development of the industrial productivity of the country to the uttermost limits consistent with social welfare. And you will observe that, in thus widening the definition of our object, I have gone no further than the Mayor [429] in his speech, when he not obscurely hinted–and most justly hinted–that in dealing with this question there are other matters than technical education, in the strict sense, to be considered.

It would be extreme presumption on my part if I were to attempt to tell an audience of gentlemen intimately acquainted with all branches of industry and commerce, such as I see before me, in what manner the practical details of the operations that we propose are to be carried out. I am absolutely ignorant both of trade and of commerce, and upon such matters I cannot venture to say a solitary word. But there is one direction in which I think it possible I may be of service–not much perhaps, but still of some,–because this matter, in the first place, involves the consideration of methods of education with which it has been my business to occupy myself during the greater part of my life; and, in the second place, it involves attention to some of those broad facts and laws of nature with which it has been my business to acquaint myself to the best of my ability. And what I think may be possible is this, that if I succeed in putting before you–as briefly as I can, but in clear and connected shape–what strikes me as the programme that we have eventually to carry out, and what are the indispensable conditions of

success, that that proceeding, whether the conclusions at which I arrive be such as you approve or as you disapprove, will nevertheless help to clear the course. [430] In this and in all complicated matters we must remember a saying of Bacon, which may be freely translated thus: "Consistent error is very often vastly more useful than muddle-headed truth." At any rate, if there be any error in the conclusions I shall put before you, I will do my best to make the error perfectly clear and plain.

Now, looking at the question of what we want to do in this broad and general way, it appears to me that it is necessary for us, in the first place, to amend and improve our system of primary education in such a fashion as will make it a proper preparation for the business of life. In the second place, I think we have to consider what measures may best be adopted for the development to its uttermost of that which may be called technical skill; and, in the third place, I think we have to consider what other matters there are for us to attend to, what other arrangements have to be kept carefully in sight in order that, while pursuing these ends, we do not forget that which is the end of civil existence, I mean a stable social state without which all other measures are merely futile, and, in effect, modes of going faster to ruin.

You are aware–no people should know the fact better than Manchester people–that, within the last seventeen years, a vast system of primary education has been created and extended over the whole country. I had some part in the original [431] organisation of this system in London, and I am glad to think that, after all these years, I can look back upon that period of my life as perhaps the part of it least wasted.

No one can doubt that this system of primary education has done wonders for our population; but, from our point of view, I do not think anybody can doubt that it still has very considerable defects. It has the defect which is common to all the educational systems which we have inherited–it is too bookish, too little practical. The child is brought too little into contact with actual facts and things, and as the system stands at present it constitutes next to no education of those particular faculties which are of the utmost importance to industrial life–I mean the faculty of observation, the faculty of working accurately, of dealing with things instead of with words. I do not propose to enlarge upon this topic, but I would venture to suggest that there are one or two remedial measures which are imperatively needed; indeed, they have already been alluded to by Mr. Acland. Those which strike me as of the greatest importance are two, and the first of them is the teaching of drawing. In my judgment, there is no mode of exercising the faculty of observation and the faculty of accurate reproduction of that which is observed, no discipline which so readily tests error in these matters, as drawing properly taught. And by that I do not mean artistic drawing; I [432] mean figuring natural objects: making plans and sections, approaching geometrical rather than artistic drawing. I do not wish to exaggerate, but I declare to you that, in my judgment, the child who has been taught to make an accurate elevation, plan and section of a pint pot has had an admirable training in accuracy of eye and hand. I am not talking about artistic education. That is not the question. Accuracy is the foundation of everything else, and instruction in artistic drawing is something which may be put off till a later stage. Nothing has struck me more in the course of my life than the loss which persons, who are pursuing scientific knowledge of any kind, sustain from the difficulties which arise because they never have been taught elementary drawing; and I am glad to say that in Eton, a school of whose governing body I have the honour of being a member, we some years ago made drawing imperative on the whole school.

The other matter in which we want some systematic and good teaching is what I have hardly a name for, but which may best be explained as a sort of developed object lessons such as Mr. Acland adverted to. Anybody who knows his business in science can make anything subservient to that purpose. You know it was said of Dean Swift that he could write an admirable poem upon a broomstick, and the man who has a real knowledge of science can make the commonest ob[433]ject in the world subservient to an introduction to the principles and greater truths of natural knowledge. It is in that way that your science must be taught if it is to be of real service. Do not suppose any amount of book work, any repetition by rote of catechisms and other abominations of that kind are of value for our object. That is mere wasting of time. But take the commonest object and lead the child from that foundation to such truths of a higher order as may be within his grasp. With regard to drawing, I do not think there is any practical difficulty; but in respect to the scientific object lessons you want teachers trained in a manner different from that which now prevails.

If it is found practicable to add further training of the hand and eye by instruction in modelling or in simple carpentry, well and good. But I should stop at this point. The elementary schools are already charged with quite as much as they can do properly; and I do not believe that any good can come of burdening them with special technical instruction. Out of that, I think, harm would come.

Now let me pass to my second point, which is the development of technical skill. Everybody here is aware that at this present moment there is hardly a branch of trade or of commerce which does not depend, more or less directly, upon some department or other of physical science, which does not involve, for its successful pursuit, reasoning from [434] scientific data. Our machinery, our chemical processes or dyeworks, and a thousand operations which it is not necessary to mention, are all directly and immediately connected with science. You have to look among your workmen and foremen for persons who shall intelligently grasp the modifications, based upon science, which are constantly being introduced into these industrial processes. I do not mean that you want professional chemists, or physicists, or mathematicians, or the like, but you want people sufficiently familiar with the broad principles which underlie industrial operations to be able to adapt themselves to new conditions. Such qualifications can only be secured by a sort of scientific instruction which occupies a midway place between those primary notions given in the elementary schools and those more advanced studies which would be carried out in the technical schools.

You are aware that, at present, a very large machinery is in operation for the purpose of giving this instruction. I don't refer merely to such work as is being done at Owens College here, for example, or at other local colleges. I allude to the larger operations of the Science and Art Department, with which I have been connected for a great many years. I constantly hear a great many objections raised to the work of the Science and Art Department. If you will allow me to say so, my connection with that department–which, I am [435] happy to say, remains, and which I am very proud of–is purely honorary; and, if it appeared to me to be right to criticise that department with merciless severity, the Lord President, if he were inclined to resent my proceedings, could do nothing more than dismiss me. Therefore you may believe that I speak with absolute impartiality. My impression is this, not that it is faultless, nor that it has not various defects, nor that there are not sundry *lacunæ* which want filling up;

but that, if we consider the conditions under which the department works, we shall see that certain defects are inseparable from those conditions. People talk of the want of flexibility of the Department, of its being bound by strict rules. Now, will any man of common sense who has had anything to do with the administration of public funds or knows the humour of the House of Commons on these matters–will any man who is in the smallest degree acquainted with the practical working of State departments of any kind, imagine that such a department could be other than bound by minutely defined regulations? Can he imagine that the work of the department should go on fairly and in such a manner as to be free from just criticism, unless it were bound by certain definite and fixed rules? I cannot imagine it.

The next objection of importance that I have heard commonly repeated is that the teaching is too theoretical, that there is insufficient practical teaching. I venture to say that there is no one [436] who has taken more pains to insist upon the comparative uselessness of scientific teaching without practical work than I have; I venture to say that there are no persons who are more cognisant of these defects in the work of the Science and Art Department than those who administer it. But those who talk in this way should acquaint themselves with the fact that proper practical instruction is a matter of no small difficulty in the present scarcity of properly taught teachers, that it is very costly, and that, in some branches of science, there are other difficulties which I won't allude to. But it is a matter of fact that, wherever it has been possible, practical teaching has been introduced, and has been made an essential element in examination; and no doubt if the House of Commons would grant unlimited means, and if proper teachers were to hand, as thick as blackberries, there would not be much difficulty in organising a complete system of practical instruction and examination ancillary to the present science classes. Those who quarrel with the present state of affairs would be better advised if, instead of groaning over the shortcomings of the present system, they would put before themselves these two questions–*is* it possible under the conditions to invent any better system? Is it possible under the conditions to enlarge the work of practical teaching and practical examination which is the one desire of those who administer the department? That is all I have to say upon that subject.

[437] Supposing we have this teaching of what I may call intermediate science, what we want next is technical instruction, in the strict sense of the word technical; I mean instruction in that kind of knowledge which is essential to the successful prosecution of the several branches of trade and industry. Now, the best way of obtaining this end is a matter about which the most experienced persons entertain very diverse opinions. I do not for one moment pretend to dogmatise about it; I can only tell you what the opinion is that I have formed from hearing the views of those who are certainly best qualified to judge, from those who have tested the various methods of conveying this instruction I think we have before us three possibilities. We have, in the first place, trade schools–I mean schools in which branches of trade are taught. We have, in the next place, schools attached to factories for the purpose of instructing young apprentices and others who go there, and who aim at becoming intelligent workmen and capable foremen. We have, lastly, the system of day classes and evening classes. With regard to the first there is this objection, that they can be attended only by those who are not obliged to earn their bread, and consequently that they will reach only a very small fraction of the population. Moreover, the expense of trade schools is enormous, and those who are best able to judge assure me that, inasmuch as the work which they do is [438] not done under conditions of pecuniary success or failure, it is apt to be too amateurish and speculative, and that it does not prepare the worker for the real conditions under

which he will have to carry out his work. In any case, the fact that the schools are very expensive, and the fact that they are accessible only to a small portion of the population, seem to me to constitute a very serious objection to them. I suppose the best of all possible organisations is that of a school attached to a factory, where the employer has an interest in seeing that the instruction given is of a thoroughly practical kind, and where the pupils pass gradually by successive stages to the position of actual workmen. Schools of this kind exist in various parts of the country, but it is obvious that they are not likely to be reached by any large part of the population; so that it appears to me we are shut up practically to schools accessible to those who are earning their bread, and in such cases they must be essentially evening classes. I am strongly of opinion that classes of this kind do an immense amount of good; that they have this admirable quality, that they involve voluntary attendance, take no man out of his position, but enable any who chooses, to make the best of the position he happens to occupy.

Suppose that all these things are desirable, what is the best way of obtaining them? I must confess that I have a strong prejudice in favour of [439] carrying out undertakings of this kind, which at first, at any rate, must be to a great extent tentative and experimental, by private effort. I don't believe that the man lives at this present time who is competent to organise a final system of technical education. I believe that all attempts made in that direction must for many years to come be experimental, and that we must get to success through a series of blunders. Now that work is far better performed by private enterprise than in any other way. But there is another method which I think is permissible, and not only permissible but highly recommendable in this case, and that is the method of allowing the locality itself in which any branch of industry is pursued to be its own judge of its own wants, and to tax itself under certain conditions for the purpose of carrying out any scheme of technical education adapted to its needs. I am aware that there are many extreme theorists of the individualist school who hold that all this is very wicked and very wrong, and that by leaving things to themselves they will get right. Well, my experience of the world is that things left to themselves don't get right. I believe it to be sound doctrine that a municipality–and the State itself for that matter–is a corporation existing for the benefit of its members, and that here, as in all other cases, it is for the majority to determine that which is for the good of the whole, and to act upon that. That is the principle [440] which underlies the whole theory of government in this country, and if it is wrong we shall have to go back a long way. But you may ask me, "This process of local taxation can only be carried out under the authority of an Act of Parliament and do you propose to let any municipality or any local authority have *carte blanche* in these matters; is the Legislature to allow it to tax the whole body of its members to any extent it pleases and for any purposes it pleases?" I should reply, certainly not.

Let me point out to you that at this present moment it passes the wit of man, so far as I know to give a legal definition of technical education. If you expect to have an Act of Parliament with a definition which shall include all that ought to be included, and exclude all that ought to be excluded, I think you will have to wait a very long time. I imagine the whole matter is in a tentative state. You don't know what you will be called upon to do, and so you must try and you must blunder. Under these circumstances it is obvious that there are two alternatives. One of these is to give a free hand to each locality. Well, it is within my knowledge that there are a good many people with wonderful, strange, and wild notions as to what ought to be done in technical education, and it is quite possible that in some places, and especially in small places, where there are few persons who take an interest in these things,

you will have [441] very remarkable projects put forth, and in that case the sole court of appeal for those taxpayers, who did not approve of such projects, would be a court of law. I suppose the judges would have to settle what is technical education. That would not be an edifying process, I think, and certainly it would be a very costly one. The other alternative is the principle adopted in the bill of last year now abandoned. I don't say whether the bill was right or wrong in detail. I am dealing now only with the principle of the bill, which appears to me to have been very often misunderstood. It has been said that it gave the whole of technical education into the hands of the Science and Art Department. It appears to me nothing could be more unfounded than that assertion. All I understand the Government proposed to do was to provide some authority who should have power to say in case any scheme was proposed, "Well, this comes within the four corners of the Act of Parliament, work it as you like;" or if it was an obviously questionable project, should take upon itself the responsibility of saying, "No, that is not what the Legislature intended; amend your scheme." There was no initiative, no control; there was simply this power of giving authority to decide upon the meaning of the Act of Parliament to a particular department of the State, whichever it might be; and it seems to me that that is a very much simpler and better process than relegating the whole question to the [442] law courts. I think that here, or anywhere else, people must be extremely sanguine if they suppose that the House of Commons and the House of Lords will ever dream of giving any local authority unlimited power to tax the inhabitants of a district for any object it pleases. I should say that was not in the range of practical politics. Well, I put that before you as a matter for your consideration.

Another very important point in this connection is the question of the supply of teachers. I should say that is one of the greatest difficulties which beset the whole problem before us. I do not wish in the slightest degree to criticise the existing system of preparing teachers for ordinary school work. I have nothing to say about it. But what I do wish to say, and what I trust I may impress on your minds firmly is this, that for the purpose of obtaining persons competent to teach science or to act as technical teachers, a different system must be adopted. For this purpose a man must know what he is about thoroughly, and be able to deal with his subject as if it were the business of his ordinary life. For this purpose, for the obtaining of teachers of science and of technical classes, the system of catching a boy or girl young, making a pupil teacher of him, compelling the poor little mortal to pour from his little bucket, into a still smaller bucket, that which has just been poured into it out [443] of a big bucket; and passing him afterwards through the training college, where his life is devoted to filling the bucket from the pump from morning till night, without time for thought or reflection, is a system which should not continue. Let me assure you that it will not do for us, that you had better give the attempt up than try that system. I remember somewhere reading of an interview between the poet Southey and a good Quaker. Southey was a man of marvellous powers of work. He had a habit of dividing his time into little parts each of which was filled up, and he told the Quaker what he did in this hour and that, and so on through the day until far into the night. The Quaker listened, and at the close said, "Well, but, friend Southey, when dost thee think?" The system which I am now adverting to is arraigned and condemned by putting that question to it. When does the unhappy pupil teacher, or over-drilled student of a training college, find any time to think? I am sure if I were in their place I could not. I repeat, that kind of thing will not do for science teachers. For science teachers must have knowledge, and knowledge is not to be acquired on these terms. The power of repetition is, but that is not knowledge. The knowledge which is absolutely requisite in dealing with young children is the knowledge you possess as you would know your own

business, and which you can just turn about as if you [444] were explaining to a boy a matter of everyday life.

So far as science teaching and technical education are concerned, the most important of all things is to provide the machinery for training proper teachers. The Department of Science and Art has been at that work for years and years, and though unable under present conditions to do so much as could be wished, it has, I believe, already begun to leaven the lump to a very considerable extent. If technical education is to be carried out on the scale at present contemplated, this particular necessity must be specially and most seriously provided for. And there is another difficulty, namely, that when you have got your science or technical teacher it may not be easy to keep him. You have educated a man–a clever fellow very likely–on the understanding that he is to be a teacher. But the business of teaching is not a very lucrative and not a very attractive one, and an able man who has had a good training is under extreme temptations to carry his knowledge and his skill to a better market, in which case you have had all your trouble for nothing. It has often occurred to me that probably nothing would be of more service in this matter than the creation of a number of not very large bursaries or exhibitions, to be gained by persons nominated by the authorities of the various science colleges and schools of the country–persons such as they [445] thought to be well qualified for the teaching business–and to be held for a certain term of years, during which the holders should be bound to teach. I believe that some measure of this kind would do more to secure a good supply of teachers than anything else. Pray note that I do not suggest that you should try to get hold of good teachers by competitive examination. That is not the best way of getting men of that special qualification. An effectual method would be to ask professors and teachers of any institution to recommend men who, to their own knowledge, are worthy of such support, and are likely to turn it to good account.

I trust I am not detaining you too long; but there remains yet one other matter which I think is of profound importance, perhaps of more importance than all the rest, on which I earnestly beg to be permitted to say some few words. It is the need, while doing all these things, of keeping an eye, and an anxious eye, upon those measures which are necessary for the preservation of that stable and sound condition of the whole social organism which is the essential condition of real progress, and a chief end of all education. You will all recollect that some time ago there was a scandal and a great outcry about certain cutlasses and bayonets which had been supplied to our troops and sailors. These warlike implements were polished as bright as rubbing could make them; they were very well [446] sharpened; they looked lovely. But when they were applied to the test of the work of war they broke and they bent, and proved more likely to hurt the hand of him that used them than to do any harm to the enemy. Let me apply that analogy to the effect of education, which is a sharpening and polishing of the mind. You may develop the intellectual side of people as far as you like, and you may confer upon them all the skill that training and instruction can give; but, if there is not, underneath all that outside form and superficial polish, the firm fibre of healthy manhood and earnest desire to do well, your labour is absolutely in vain.

Let me further call your attention to the fact that the terrible battle of competition between the different nations of the world is no transitory phenomenon, and does not depend upon this or that fluctuation of the market, or upon any condition that is likely to pass away. It is the inevitable result of that which takes place throughout nature and affects man's part of nature as much as any other–namely, the struggle

for existence, arising out of the constant tendency of all creatures in the animated world to multiply indefinitely. It is that, if you look at it, which is at the bottom of all the great movements of history. It is that inherent tendency of the social organism to generate the causes of its own destruction, never yet counteracted, which has been at the bottom of half the [447] catastrophes which have ruined States. We are at present in the swim of one of those vast movements in which, with a population far in excess of that which we can feed, we are saved from a catastrophe, through the impossibility of feeding them, solely by our possession of a fair share of the markets of the world. And in order that that fair share may be retained, it is absolutely necessary that we should be able to produce commodities which we can exchange with food-growing people, and which they will take, rather than those of our rivals, on the ground of their greater cheapness or of their greater excellence; that is the whole story. And our course, let me say, is not actuated by mere motives of ambition or by mere motives of greed. Those doubtless are visible enough on the surface of these great movements, but the movements themselves have far deeper sources. If there were no such things as ambition and greed in this world, the struggle for existence would arise from the same causes.

Our sole chance of succeeding in a competition, which must constantly become more and more severe, is that our people shall not only have the knowledge and the skill which are required, but that they shall have the will and the energy and the honesty, without which neither knowledge nor skill can be of any permanent avail. This is what I mean by a stable social condition, because any [448] other condition than this, any social condition in which the development of wealth involves the misery, the physical weakness, and the degradation of the worker, is absolutely and infallibly doomed to collapse. Your bayonets and cutlasses will break under your hand, and there will go on accumulating in society a mass of hopeless, physically incompetent, and morally degraded people, who are, as it were, a sort of dynamite which, sooner or later, when its accumulation becomes sufficient and its tension intolerable, will burst the whole fabric.

I am quite aware that the problem which I have put before you and which you know as much about as I do, and a great deal more probably, is one extremely difficult to solve. I am fully aware that one great factor in industrial success is reasonable cheapness of labour. That has been pointed out over and over again, and is in itself an axiomatic proposition. And it seems to me that of all the social questions which face us at this present time, the most serious is how to steer a clear course between the two horns of an obvious dilemma. One of these is the constant tendency of competition to lower wages beyond a point at which man can remain man–below a point at which decency and cleanliness and order and habits of morality and justice can reasonably be expected to exist. And the other horn of the dilemma is the difficulty of maintaining wages [449] above this point consistently with success in industrial competition. I have not the remotest conception how this problem will eventually work itself out; but of this I am perfectly convinced, that the sole course compatible with safety lies between the two extremes; between the Scylla of successful industrial production with a degraded population, on the one side, and the Charybdis of a population, maintained in a reasonable and decent state, with failure in industrial competition, on the other side. Having this strong conviction, which, indeed, I imagine must be that of every person who has ever thought seriously about these great problems, I have ventured to put it before you in this bare and almost cynical fashion because it will justify the strong appeal, which I make to all concerned in this work of promoting industrial education, to have a care, at the same time, that the

conditions of industrial life remain those in which the physical energies of the population may be maintained at a proper level; in which their moral state may be cared for; in which there may be some rays of hope and pleasure in their lives; and in which the sole prospect of a life of labour may not be an old age of penury.

These are the chief suggestions I have to offer to you, though I have omitted much that I should like to have said, had time permitted. It may be that some of you feel inclined to look upon them as the Utopian dreams of a student. If there be [450] such, let me tell you that there are, to my knowledge, manufacturing towns in this country, not one-tenth the size, or boasting one-hundredth part of the wealth, of Manchester, in which I do not say that the programme that I have put before you is completely carried out, but in which, at any rate, a wise and intelligent effort had been made to realise it, and in which the main parts of the programme are in course of being worked out. This is not the first time that I have had the privilege and pleasure of addressing a Manchester audience. I have often enough, before now, thrown myself with entire confidence upon the hard-headed intelligence and the very soft-hearted kindness of Manchester people, when I have had a difficult and complicated scientific argument to put before them. If, after the considerations which I have put before you–and which, pray be it understood, I by no means claim particularly for myself, for I presume they must be in the minds of a large number of people who have thought about this matter–if it be that these ideas commend themselves to your mature reflection, then I am perfectly certain that my appeal to you to carry them into practice, with that abundant energy and will which have led you to take a foremost part in the great social movements of our country many a time beforehand, will not be made in vain. I therefore confidently appeal to you to let those impulses once more have full sway, and [451] not to rest until you have done something better and greater than has yet been done in this country in the direction in which we are now going. I heartily thank you for the attention which you have been kind enough to bestow upon me. The practice of public speaking is one I must soon think of leaving off, and I count it a special and peculiar honour to have had the opportunity of speaking to you on this subject to-day.

THE HUXLEY FILE

Preface and Table of Contents to Volume III, *Science & Education*, of Huxley's *Collected Essays.*

Previous article: Technical Education [1877], pages 404-426.

Preface and Table of Contents to the next volume, Volume IV, of Huxley's *Collected Essays.*

C. Blinderman & D. Joyce
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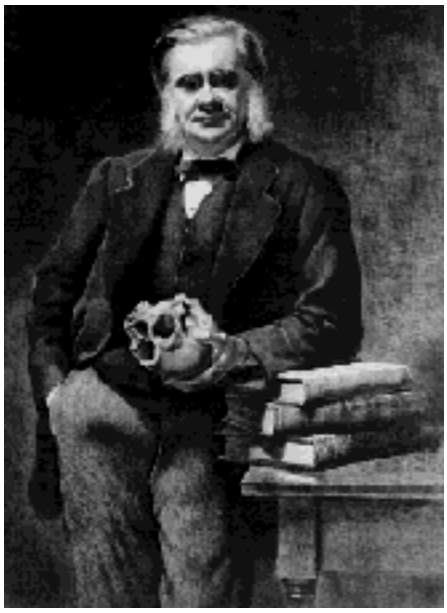

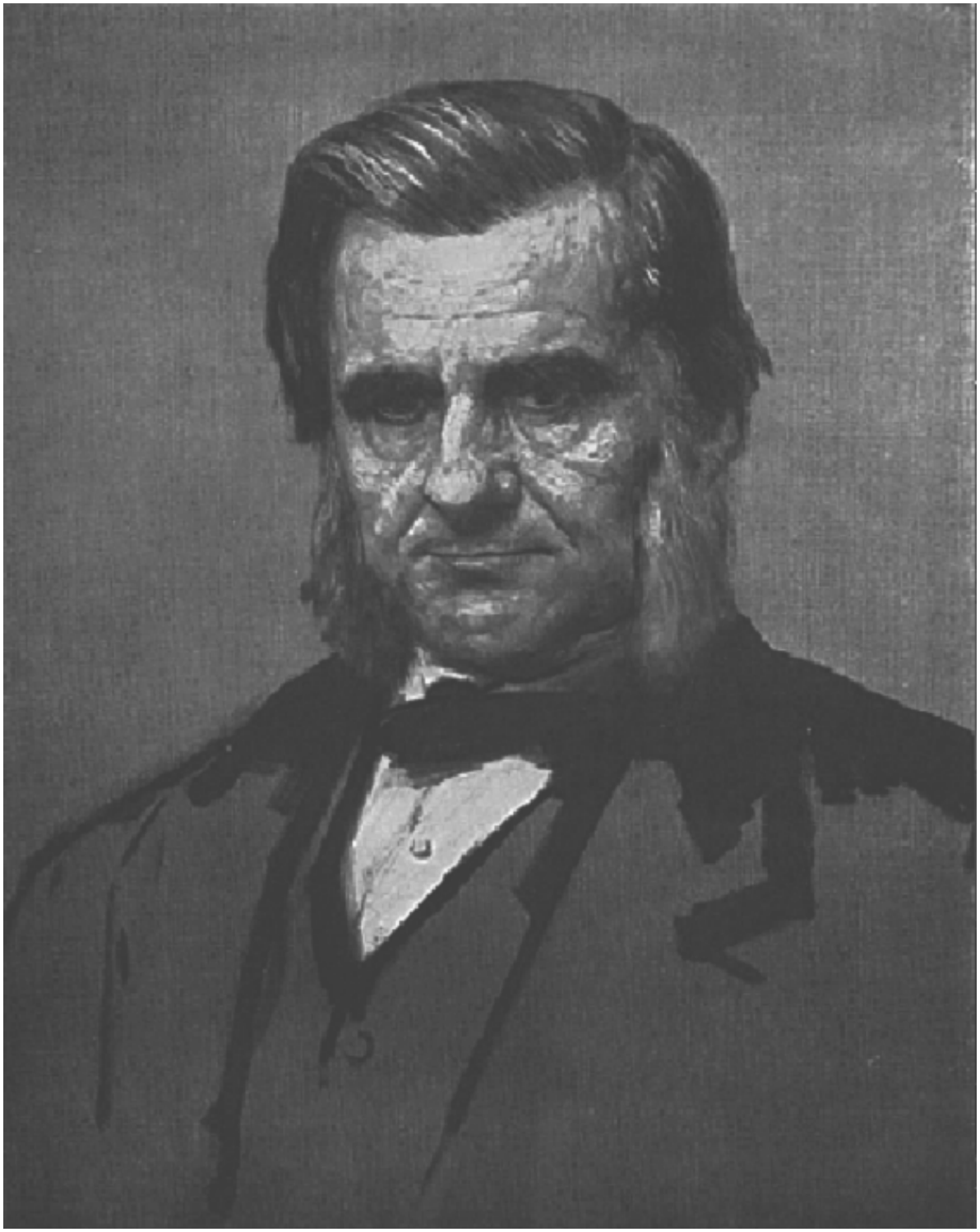

Minister

Sketch by Alphonse Legros (1879) - In 1869, at Sion College,

T. H. H. had identified himself as a minister.

Huxley Archives

On the Method of Zadig

Retrospective Prophecy as a Function of Science (1880)

Collected Essays IV

"Une marque plus sûre que toutes celles de Zadig."[1] –Cuvier.

[1] It is an usual and a commendable practice to preface the discussion of the views of a philosophic thinker by some account of the man and of the circumstances which shaped his life and coloured his way of looking at things; but, though Zadig is cited in one of the most important chapters of Cuvier's greatest work, little is known about him, and that little might perhaps be better authenticated than it is.

It is said that he lived at Babylon in the time of King Moabdar; but the name of Moabdar does not appear in the list of Babylonian sovereigns [2] brought to light by the patience and the industry of the decipherers of cuneiform inscriptions in these later years; nor indeed am I aware that there is any other authority for his existence than that of the biographer of Zadig, one Arouet de Voltaire, among whose more conspicuous merits strict historical accuracy is perhaps hardly to be reckoned.

Happily Zadig is in the position of a great many other philosophers. What he was like when he was in the flesh, indeed whether he existed at all, are matters of no great consequence. What we care about in a light is that it shows the way, not whether it is lamp or candle, tallow or wax. Our only real interest in Zadig lies in the conceptions of which he is the putative father; and his biographer has stated these with so much clearness and vivacious illustration, that we need hardly feel a pang, even if critical research should prove King Moabdar and all the rest of the story to be unhistorical, and reduce Zadig himself to the shadowy condition of a solar myth.

Voltaire tells us that, disenchanted with life by sundry domestic misadventures, Zadig withdrew from the turmoil of Babylon to a secluded retreat on the banks of the Euphrates, where he beguiled his solitude by the study of nature. The manifold wonders of the world of life had a particular attraction for the lonely student; incessant and patient observation of the plants and animals [3] about him sharpened his naturally good powers of observation and of reasoning; until, at length, he acquired a sagacity which enabled him to perceive endless minute differences among objects which, to the untutored eye, appeared absolutely alike.

It might have been expected that this enlargement of the powers of the mind and of its store of natural knowledge could tend to nothing but the increase of a man's own welfare and the good of his fellow-men. But Zadig was fated to experience the vanity of such expectations.

"One day, walking near a little wood, he saw, hastening that way, one of the Queen's chief eunuchs, followed by

a troop of officials, who appeared to be in the greatest anxiety, running hither and thither like men distraught, in search of some lost treasure.

"'Young man,' cried the eunuch, 'have you seen the Queen's dog?' Zadig answered modestly, 'A bitch, I think, not a dog.' 'Quite right,' replied the eunuch; and Zadig continued, 'A very small spaniel who has lately had puppies; she limps with the left foreleg, and has very long ears.' 'Ah! you have seen her then,' said the breathless eunuch. 'No,' answered Zadig, 'I have not seen her; and I really was not aware that the Queen possessed a spaniel.'

"By an odd coincidence, at the very same time, the handsomest horse in the King's stables broke away from his groom in the Babylonian plain. The grand huntsman and all his staff were seeking the horse with as much anxiety as the eunuch and his people the spaniel; and the grand huntsman asked Zadig if he had not seen the King's horse go that way.

"'A first-rate galloper, small-hoofed, five feet high; tail three feet and a half long; cheek pieces of the bit of twenty-three carat gold; shoes silver?' said Zadig.

[4] "'Which way did he go? Where is he?' cried the grand huntsman.

"'I have not seen anything of the horse, and I never heard of him before,' replied Zadig.

"The grand huntsman and the chief eunuch made sure that Zadig had stolen both the King's horse and the Queen's spaniel, so they haled him before the High Court of Desterham, which at once condemned him to the knout, and transportation for life to Siberia. But the sentence was hardly pronounced when the lost horse and spaniel were found. So the judges were under the painful necessity of reconsidering their decision: but they fined Zadig four hundred ounces of gold for saying he had seen that which he had not seen.

"The first thing was to pay the fine; afterwards Zadig was permitted to open his defence to the court, which he did in the following terms:

"'Stars of justice, abysses of knowledge, mirrors of truth, whose gravity is as that of lead, whose inflexibility is as that of iron, who rival the diamond in clearness, and possess no little affinity with gold; since I am permitted to address your august assembly, I swear by Ormuzd that I have never seen the respectable lady dog of the Queen, nor beheld the sacrosanct horse of the King of Kings.

"'This is what happened. I was taking a walk towards the little wood near which I subsequently had the honour to meet the venerable chief eunuch and the most illustrious grand huntsman. I noticed the track of an animal in the sand, and it was easy to see that it was that of a small dog. Long faint streaks upon the little elevations of sand between the footmarks convinced me that it was a she dog with pendent dugs, showing that she must have had puppies not many days since. Other scrapings of the sand, which always lay close to the marks of the forepaws, indicated that she had very long ears; and, as the imprint of one foot was always fainter than those of the other three, I judged that the lady dog of our august Queen was, if I may venture to say so, a little lame.

"'With respect to the horse of the King of Kings, permit me to observe that, wandering through the paths which traverse the [5] wood, I noticed the marks of horse-shoes. They were all equidistant. "Ah!" said I, "this is a

famous galloper." In a narrow alley, only seven feet wide, the dust upon the trunks of the trees was a little disturbed at three feet and a half from the middle of the path. "This horse," said I to myself, "had a tail three feet and a half long, and, lashing it from one side to the other, he has swept away the dust." Branches of the trees met overhead at the height of five feet, and under them I saw newly fallen leaves; so I knew that the horse had brushed some of the branches, and was therefore five feet high. As to his bit, it must have been made of twenty-three carat gold, for he had rubbed it against a stone, which turned out to be a touchstone, with the properties of which I am familiar by experiment. Lastly, by the marks which his shoes left upon pebbles of another kind, I was led to think that his shoes were of fine silver.'

"All the judges admired Zadig's profound and subtle discernment; and the fame of it reached even the King and the Queen. From the ante-rooms to the presence-chamber, Zadig's name was in everybody's mouth; and, although many of the magi were of opinion that he ought to be burnt as a sorcerer, the King commanded that the four hundred ounces of gold which he had been fined should be restored to him. So the officers of the court went in state with the four hundred ounces; only they retained three hundred and ninety-eight for legal expenses, and their servants expected fees."

Those who are interested in learning more of the fateful history of Zadig must turn to the original; we are dealing with him only as a philosopher, and this brief excerpt suffices for the exemplification of the nature of his conclusions and of the methods by which he arrived at them.

These conclusions may be said to be of the nature of retrospective prophecies; though it is perhaps a little hazardous to employ phraseology [6] which perilously suggests a contradiction in terms–the word "prophecy" being so constantly, in ordinary use, restricted to "foretelling." Strictly, however, the term prophecy applies as much to outspeaking as to foretelling; and, even in the restricted sense of "divination," it is obvious that the essence of the prophetic operation does not lie in its backward or forward relation to the course of time, but in the fact that it is the apprehension of that which lies out of the sphere of immediate knowledge; the seeing of that which, to the natural sense of the seer, is invisible.

The foreteller asserts that, at some future time, a properly situated observer will witness certain events; the clairvoyant declares that, at this present time, certain things are to be witnessed a thousand miles away; the retrospective prophet (would that there were such a word as "backteller!") affirms that, so many hours or years ago, such and such things were to be seen. In all these cases, it is only the relation to time which alters–the process of divination beyond the limits of possible direct knowledge remains the same.

No doubt it was their instinctive recognition of the analogy between Zadig's results and those obtained by authorised inspiration which inspired the Babylonian magi with the desire to burn the philosopher. Zadig admitted that he had never either seen or heard of the horse of the king or of the spaniel of the queen; and yet he ventured to assert in [7] the most positive manner that animals answering to their description did actually exist and ran about the plains of Babylon. If his method was good for the divination of the course of events ten hours old, why should it not be good for those of ten years or ten centuries past; nay, might it not extend ten thousand years and justify the impious in meddling with the traditions of Oannes and the fish, and all the sacred foundations of Babylonian cosmogony?

But this was not the worst. There was another consideration which obviously dictated to the more thoughtful of the magi the propriety of burning Zadig out of hand. His defence was worse than his offence. It showed that his mode of divination was fraught with danger to magianism in general. Swollen with the pride of human reason, he had ignored the established canons of magian lore; and, trusting to what after all was mere carnal common sense, he professed to lead men to a deeper insight into nature than magian wisdom, with all its lofty antagonism to everything common, had ever reached. What, in fact, lay at the foundation of all Zadig's argument but the coarse commonplace assumption, upon which every act of our daily lives is based, that we may conclude from an effect to the pre-existence of a cause competent to produce that effect?

The tracks were exactly like those which dogs and horses leave; therefore they were the effects [8] of such animals as causes. The marks at the sides of the fore-prints of the dog track were exactly such as would be produced by long trailing ears; therefore the dog's long ears were the causes of these marks–and so on. Nothing can be more hopelessly vulgar, more unlike the majestic development of a system of grandly unintelligible conclusions from sublimely inconceivable premisses such as delights the magian heart. In fact, Zadig's method was nothing but the method of all mankind. Retrospective prophecies, far more astonishing for their minute accuracy than those of Zadig, are familiar to those who have watched the daily life of nomadic people.

From freshly broken twigs, crushed leaves, disturbed pebbles, and imprints hardly discernible by the untrained eye, such graduates in the University of Nature will divine, not only the fact that a party has passed that way, but its strength, its composition, the course it took, and the number of hours or days which have elapsed since it passed. But they are able to do this because, like Zadig, they perceive endless minute differences where untrained eyes discern nothing; and because the unconscious logic of common sense compels them to account for these effects by the causes which they know to be competent to produce them.

And such mere methodised savagery was to discover the hidden things of nature better than *a priori* deductions from the nature of Ormuzd–[9] perhaps to give a history of the past, in which Oannes would be altogether ignored! Decidedly it were better to burn this man at once.

If instinct, or an unwonted use of reason, led Moabdar's magi to this conclusion two or three thousand years ago, all that can be said is that subsequent history has fully justified them. For the rigorous application of Zadig's logic to the results of accurate and long-continued observation has founded all those sciences which have been termed historical or palætiological, because they are retrospectively prophetic and strive towards the reconstruction in human imagination of events which have vanished and ceased to be.

History, in the ordinary acceptation of the word, is based upon the interpretation of documentary evidence; and documents would have no evidential value unless historians were justified in their assumption that they have come into existence by the operation of causes similar to those of which documents are, in our present experience, the effects. If a written history can be produced otherwise than

by human agency, or if the man who wrote a given document was actuated by other than ordinary human motives, such documents are of no more evidential value than so many arabesques.

Archæology, which takes up the thread of history beyond the point at which documentary evidence fails us, could have no existence, except [10] for our well grounded confidence that monuments and works of art or artifice, have never been produced by causes different in kind from those to which they now owe their origin. And geology, which traces back the course of history beyond the limits of archæology, could tell us nothing except for the assumption that, millions of years ago, water, heat, gravitation, friction, animal and vegetable life, caused effects of the same kind as they now cause. Nay, even physical astronomy, in so far as it takes us back to the uttermost point of time which palætiological science can reach, is founded upon the same assumption. If the law of gravitation ever failed to be true, even to a small extent, for that period, the calculations of the astronomer have no application.

The power of prediction, of prospective prophecy, is that which is commonly regarded as the great prerogative of physical science. And truly it is a wonderful fact that one can go into a shop and buy for a small price a book, the "Nautical Almanac," which will foretell the exact position to be occupied by one of Jupiter's moons six months hence; nay, more, that, if it were worth while, the Astronomer-Royal could furnish us with as infallible a prediction applicable to 1980 or 2980.

But astronomy is not less remarkable for its power of retrospective prophecy.

Thales, oldest of Greek philosophers, the dates [11] of whose birth and death are uncertain, but who flourished about 600 B. C., is said to have foretold an eclipse of the sun which took place in his time during a battle between the Medes and the Lydians. Sir George Airy has written a very learned and interesting memoir[2] in which he proves that such an eclipse was visible in Lydia on the afternoon of the 28th of May in the year 585 B.C.

No one doubts that, on the day and at the hour mentioned by the Astronomer-Royal, the people of Lydia saw the face of the sun totally obscured. But, though we implicitly believe this retrospective prophecy, it is incapable of verification. In the total absence of historical records, it is impossible even to conceive any means of ascertaining directly whether the eclipse of Thales happened or not. All that can be said is, that the prospective prophecies of the astronomer are always verified; and that, inasmuch as his retrospective prophecies are the result of following backwards, the very same method as that which invariably leads to verified results, when it is worked forwards, there is as much reason for placing full confidence in the one as in the other. Retrospective prophecy is therefore a legitimate function of astronomical science; and if it is legitimate for one science it is legitimate for [12] all; the fundamental axiom on which it rests, the constancy of the order of nature, being the common foundation of all scientific thought. Indeed, if there can be grades in legitimacy, certain branches of science have the advantage over astronomy, in so far as their retrospective prophecies are not only susceptible of verification, but are sometimes strikingly verified.

Such a science exists in that application of the principles of biology to the interpretation of the animal

and vegetable remains imbedded in the rocks which compose the surface of the globe, which is called Palæontology.

At no very distant time, the question whether these so-called "fossils," were really the remains of animals and plants was hotly disputed. Very learned persons maintained that they were nothing of the kind, but a sort of concretion, or crystallisation, which had taken place within the stone in which they are found; and which simulated the forms of animal and vegetable life, just as frost on a window-pane imitates vegetation. At the present day, it would probably be impossible to find any sane advocate of this opinion; and the fact is rather surprising, that among the people from whom the circle-squarers, perpetual-motioners, flat-earthed men and the like, are recruited, to say nothing of table-turners and spirit-rappers, somebody has not perceived the easy avenue to nonsensical notoriety open to any [13] one who will take up the good old doctrine, that fossils are all *lusus naturæ*.

The position would be impregnable, inasmuch as it is quite impossible to prove the contrary. If a man choose to maintain that a fossil oyster shell, in spite of its correspondence, down to every minutest particular, with that of an oyster fresh taken out of the sea, was never tenanted by a living oyster, but is a mineral concretion, there is no demonstrating his error. All that can be done is to show him that, by a parity of reasoning, he is bound to admit that a heap of oyster shells outside a fishmonger's door may also be "sports of nature," and that a mutton bone in a dust-bin may have had the like origin. And when you cannot prove that people are wrong, but only that they are absurd, the best course is to let them alone.

The whole fabric of palæontology, in fact, falls to the ground unless we admit the validity of Zadig's great principle, that like effects imply like causes, and that the process of reasoning from a shell, or a tooth, or a bone, to the nature of the animal to which it belonged, rests absolutely on the assumption that the likeness of this shell, or tooth, or bone, to that of some animal with which we are already acquainted, is such that we are justified in inferring a corresponding degree of likeness in the rest of the two organisms. It is on this very simple principle, and not upon imaginary [14] laws of physiological correlation, about which, in most cases, we know nothing whatever, that the so-called restorations of the palæontologist are based.

Abundant illustrations of this truth will occur to every one who is familiar with palæontology; none is more suitable than the case of the so-called *Belemnites*. In the early days of the study of fossils, this name was given to certain elongated stony bodies, ending at one extremity in a conical point, and truncated at the other, which were commonly reputed to be thunderbolts, and as such to have descended from the sky. They are common enough in some parts of England; and, in the condition in which they are ordinarily found, it might be difficult to give satisfactory reasons for denying them to be merely mineral bodies.

They appear, in fact, to consist of nothing but concentric layers of carbonate of lime, disposed in subcrystalline fibres, or prisms, perpendicular to the layers. Among a great number of specimens of these Belemnites, however, it was soon observed that some showed a conical cavity at the blunt end;

and, in still better preserved specimens, this cavity appeared to be divided into chambers by delicate saucer-shaped partitions, situated at regular intervals one above the other. Now there is no mineral body which presents any structure comparable to this, and the conclusion suggested itself that the Belemnites must be the effects of [15] causes other than those which are at work in inorganic nature. On close examination, the saucer-shaped partitions were proved to be all perforated at one point, and the perforations being situated exactly in the same line, the chambers were seen to be traversed by a canal, or *siphuncle*, which thus connected the smallest or aphical chamber with the largest. There is nothing like this in the vegetable world; but an exactly corresponding structure is met with in the shells of two kinds of existing animals, the pearly *Nautilus* and the *Spirula*, and only in them. These animals belong to the same division–the *Cephalopoda*–as the cuttle-fish, the squid, and the octopus. But they are the only existing members of the group which possess chambered, siphunculated shells; and it is utterly impossible to trace any physiological connection between the very peculiar structural characters of a cephalopod and the presence of a chambered shell. In fact, the squid has, instead of any such shell, a horny "pen," the cuttlefish has the so-called "cuttle-bone," and the octopus has no shell, or, at most, a mere rudiment of one.

Nevertheless, seeing that there is nothing in nature at all like the chambered shell of the Belemnite, except the shells of the *Nautilus* and of the *Spirula*, it was legitimate to prophesy that the animal from which the fossil proceeded must have belonged to the group of the *Cephalopoda*. [16] *Nautilus* and *Spirula* are both very rare animals, but the progress of investigation brought to light the singular fact, that, though each has the characteristic cephalopodous organisation, it is very different from the other. The shell of *Nautilus* is external, that of *Spirula* internal; *Nautilus* has four gills, *Spirula* two; *Nautilus* has multitudinous tentacles, *Spirula* has only ten arms beset with horny-rimmed suckers; *Spirula*, like the squids and cuttle-fishes, which it closely resembles, has a bag of ink which it squirts out to cover its retreat when alarmed; *Nautilus* has none.

No amount of physiological reasoning could enable any one to say whether the animal which fabricated the Belemnite was more like *Nautilus*, or more like *Spirula*. But the accidental discovery of Belemnites in due connection with black elongated masses which were: certainly fossilised ink-bags, inasmuch as the ink could be ground up and used for painting as well as if it were recent sepia, settled the question; and it became perfectly safe to prophesy that the creature which fabricated the Belemnite was a two-gilled cephalopod with suckers on its arms, and with all the other essential features of our living squids, cuttle-fishes, and *Spirulæ*. The palæontologist was, by this time, able to speak as confidently about the animal of the Belemnite, as Zadig was respecting the queen's spaniel. He could give a very fair description of its external appearance, and even enter pretty [17] fully into the details of its internal organisation, and yet could declare that neither he, nor any one else, had ever seen one. And as the queen's spaniel was found, so happily has the animal of the Belemnite; a few exceptionally preserved specimens have been discovered, which completely verify the retrospective prophecy of those who interpreted the facts of the case by due application of the method of Zadig.

These Belemnites flourished in prodigious abundance in the seas of the mesozoic, or secondary, age of the world's geological history; but no trace of them has been found in any of the tertiary deposits, and they appear to have died out towards the close of the mesozoic epoch. The method of Zadig, therefore,

applies in full force to the events of a period which is immeasurably remote, which long preceded the origin of the most conspicuous mountain masses of the present world, and the deposition, at the bottom of the ocean, of the rocks which form the greater part of the soil of our present continents. The Euphrates itself, at the mouth of which Oannes landed, is a thing of yesterday compared with a Belemnite; and even the liberal chronology of magian cosmogony fixes the beginning of the world only at a time when other applications of Zadig's method afford convincing evidence that, could we have been there to see, things would have looked very much as they do now. Truly the magi were wise [18] in their generation; they foresaw rightly that this pestilent application of the principles of common sense, inaugurated by Zadig, would be their ruin.

But it may be said that the method of Zadig, which is simple reasoning from analogy, does not account for the most striking feats of modern palæontology–the reconstruction of entire animals from a tooth or perhaps a fragment of a bone; and it may be justly urged that Cuvier, the great master of this kind of investigation, gave a very different account of the process which yielded such remarkable results.

Cuvier is not the first man of ability who has failed to make his own mental processes clear to himself, and he will not be the last. The matter can be easily tested. Search the eight volumes of the "Recherches sur les Ossemens Fossiles" from cover to cover, and nothing but the application of the method of Zadig will be found in the arguments by which a fragment of a skeleton is made to reveal the characters of the animal to which it belonged.

There is one well-known case which may represent all. It is an excellent illustration of Cuvier's sagacity, and he evidently takes some pride in telling his story about it. A split slab of stone arrived from the quarries of Montmartre, the two halves of which contained the greater part of the skeleton of a small animal. On careful examina[19]tions of the characters of the teeth and of the lower jaw, which happened to be exposed, Cuvier assured himself that they presented such a very close resemblance to the corresponding parts in the living opossums that he at once assigned the fossil to that genus.

Now the opossums are unlike most mammals in that they possess two bones attached to the fore part of the pelvis, which are commonly called "marsupial bones." The name is a misnomer, originally conferred because it was thought that these bones have something to do with the support of the pouch, or marsupium, with which some, but not all, of the opossums are provided. As a matter of fact, they have nothing to do with the support of the pouch, and they exist as much in those opossums which have no pouches as in those which possess them. In truth, no one knows what the use of these bones may be, nor has any valid theory of their physiological import yet been suggested. And if we have no knowledge of the physiological importance of the bones themselves, it is obviously absurd to pretend that we are able to give physiological reasons why the presence of these bones is associated with certain peculiarities of the teeth and of the jaws. If any one knows why four molar teeth and an inflected angle of the jaw are very generally found along with marsupial bones, he has not yet communicated that knowledge to the world.

[20] If, however, Zadig was right in concluding from the likeness of the hoof-prints which he observed

to be a horse's that the creature which made them had a tail like that of a horse, Cuvier, seeing that the teeth and jaw of his fossil were just like those of an opossum, had the same right to conclude that the pelvis would also be like an opossum's; and so strong was his conviction that this retrospective prophecy, about an animal which he had never seen before, and which had been dead and buried for millions of years, would be verified, that he went to work upon the slab which contained the pelvis in confident expectation of finding and laying bare the "marsupial bones," to the satisfaction of some persons whom he had invited to witness their disinterment. As he says:–"Cette opération se fit en présence de quelques personnes à qui j'en avais annoncé d'avance le résultat, dans l'intention de leur prouver par le fait la justice de nos théories zoologiques; puisque le vrai cachet d'une théorie est sans contredit la faculté qu'elle donne de prévoir les phénomènes."

In the "Ossemens Fossiles" Cuvier leaves his paper just as it first appeared in the "Annales du Muséum," as "a curious monument of the force of zoological laws and of the use which may be made of them."

Zoological laws truly, but not physiological laws. If one sees a live dog's head, it is extremely probable that a dog's tail is not far off, though nobody [21] can say why that sort of head and that sort of tail go together; what physiological connection there is between the two. So, in the case of the Montmartre fossil, Cuvier, finding a thorough opossum's head, concluded that the pelvis also would be like an opossum's. But, most assuredly, the most advanced physiologist of the present day could throw no light on the question why these are associated, nor could pretend to affirm that the existence of the one is necessarily connected with that of the other. In fact, had it so happened that the pelvis of the fossil had been originally exposed, while the head lay hidden, the presence of the "marsupial bones," though very like an opossum's, would by no means have warranted the prediction that the skull would turn out to be that of the opossum. It might just as well have been like that of some other marsupial; or even like that of the totally different group of Monotremes, of which the only living representatives are the *Echidna* and the *Ornithorhynchus.*

For all practical purposes, however, the empirical laws of co-ordination of structures, which are embodied in the generalisations of morphology, may be confidently trusted, if employed with due caution, to lead to a just interpretation of fossil remains; or, in other words, we may look for the verification of the retrospective prophecies which are based upon them.

[22] And if this be the case, the late advances which have been made in palæontological discovery open out a new field for such prophecies. For it has been ascertained with respect to many groups of animals, that, as we trace them back in time, their ancestors gradually cease to exhibit those special modifications which at present characterise the type, and more nearly embody the general plan of the group to which they belong.

Thus, in the well-known case of the horse, the toes which are suppressed in the living horse are found to be more and more complete in the older members of the group, until, at the bottom of the Tertiary series of America, we find an equine animal which has four toes in front and three behind. No remains of the horse tribe are at present known from any Mesozoic deposit. Yet who can doubt that, whenever a

sufficiently extensive series of lacustrine and fluviatile beds of that age becomes known, the lineage which has been traced thus far will be continued by equine quadrupeds with an increasing number of digits, until the horse type merges in the five-toed form towards which these gradations point?

But the argument which holds good for the horse, holds good, not only for all mammals, but for the whole animal world. And as the study of the pedigrees, or lines of evolution, to which, at present, we have access, brings to light, as it assuredly will do, the laws of that process, we [23] shall be able to reason from the facts with which the geological record furnishes us to those which have hitherto remained, and many of which, perhaps, may for ever remain, hidden. The same method of reasoning which enables us, when furnished with a fragment of an extinct animal, to prophesy the character which the whole organism exhibited, will, sooner or later, enable us, when we know a few of the later terms of a genealogical series, to predict the nature of the earlier terms.

In no very distant future, the method of Zadig, applied to a greater body of facts than the present generation is fortunate enough to handle, will enable the biologist to reconstruct the scheme of life from its beginning, and to speak as confidently of the character of long extinct beings, no trace of which has been preserved, as Zadig did of the queen's spaniel and the king's horse. Let us hope that they may be better rewarded for their toil and their sagacity than was the Babylonian philosopher; for perhaps, by that time, the magi also may be reckoned among the members of a forgotten Fauna, extinguished in the struggle for existence against their great rival, common sense.

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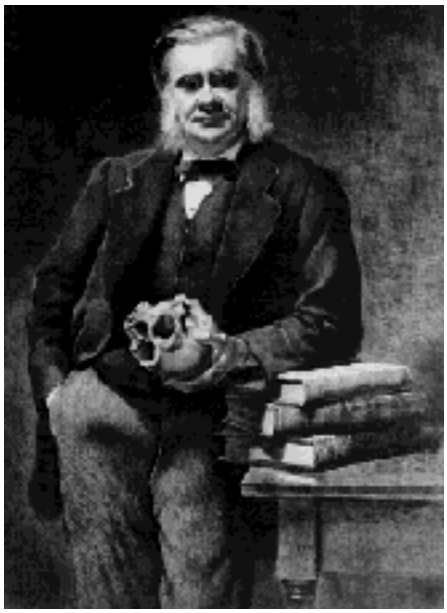
[1] "Discours sur les révolutions de la surface du globe." *Recherches sur les Ossemens Fossiles*, Ed.iv, t.i. p.185.]

[2] "On the Eclipses of Agathocles, Thales, and Xerxes," *Philosophical Transactions*, vol. cxliii.



The Rise and Progress of Palæontology (1881)

Collected Essays IV

[24] That application of the sciences of biology and geology, which is commonly known as palæontology, took its origin in the mind of the first person who, finding something like a shell, or a bone, naturally imbedded in gravel or rock, indulged in speculations upon the nature of this thing which he had dug out–this "fossil"–and upon the causes which had brought it into such a position. In this rudimentary form, a high antiquity may safely be ascribed to palæontology, inasmuch as we know that, 500 years before the Christian era, the philosophic doctrines of Xenophanes were influenced by his observations upon the fossil remains exposed in the quarries of Syracuse. From this time forth not only the philosophers, but the poets, the historians, the geographers of antiquity occasionally refer to fossils; and, after the revival of learning, lively controversies arose respecting their real nature. [25] But hardly more than two centuries have elapsed since this fundamental problem was first exhaustively treated; it was only in the last century that the archæological value of fossils–their importance, I mean, as records of the history of the earth–was fully recognised; the first adequate investigation of the fossil remains of any large group of vertebrated animals is to be found in Cuvier's "Recherches sur les Ossemens Fossiles," completed in 1822; and, so modern is stratigraphical palæontology, that its founder, William Smith, lived to receive the just recognition of his services by the award of the first Wollaston Medal in 1831.

But, although palæontology is a comparatively youthful scientific speciality, the mass of materials with which it has to deal is already prodigious. In the last fifty years the number of known fossil remains of invertebrated animals has been trebled or quadrupled. The work of interpretation of vertebrate fossils, the foundations of which were so solidly laid by Cuvier, was carried on, with wonderful vigour and success, by Agassiz in Switzerland, by Von Meyer in Germany, and last, but not least, by Owen in this country, while, in later years, a multitude of workers have laboured in the same field. In many groups of the animal kingdom the number of fossil forms already known is as great as that of the existing species. In some cases it is much greater; and there are [26] entire orders of animals of the existence of which we should know nothing except for the evidence afforded by fossil remains. With all this it may be safely assumed that, at the present moment, we are not acquainted with a tittle of the fossils which will sooner or later be discovered. If we may judge by the profusion yielded within the last few years by the Tertiary formations of North America, there seems to be no limit to the multitude of mammalian remains to be expected from that continent; and analogy leads us to expect similar riches in Eastern Asia, whenever the Tertiary formations of that region are as carefully explored. Again, we have, as yet, almost everything to learn respecting the terrestrial population of the Mesozoic epoch; and it seems as if the Western territories of the United States were about to prove as instructive in regard to this point as they have in respect of tertiary life. My friend Professor Marsh informs me that, within two years, remains of more than 160 distinct individuals of mammals, belonging to twenty species and nine genera, have been found in a space not larger than the floor of a good-sized room; while beds of the same age have yielded 300 reptiles, varying in size from a length of 60 feet or 80 feet to the dimensions of a rabbit.

The task which I have set myself to-night is to endeavour to lay before you, as briefly as possible, a sketch of the successive steps by which our [27] present knowledge of the facts of palæontology and of those conclusions from them which are indisputable, has been attained; and I beg leave to remind you, at the outset, that in attempting to sketch the progress of a branch of knowledge to which innumerable labours have contributed, my business is rather with generalisations than with details. It is my object to mark the epochs of palæontology, not to recount all the events of its history.

That which I just now called the fundamental problem of palæontology, the question which has to be settled before any other can be profitably discussed, is this, What is the nature of fossils? Are they, as the healthy common sense of the ancient Greeks appears to have led them to assume without hesitation, the remains of animals and plants? Or are they, as was so generally maintained in the fifteenth, sixteenth, and seventeenth centuries, mere figured stones, portions of mineral matter which have assumed the forms of leaves and shells and bones, just as those portions of mineral matter which we call crystals take on the form of regular geometrical solids? Or, again, are they, as others thought, the products of the germs of animals and of the seeds of plants which have lost their way, as it were, in the bowels of the earth, and have achieved only an imperfect and abortive development? It is easy to sneer at our ancestors for being disposed to reject the first [28] in favour of one or other of the last two hypotheses; but it is much more profitable to try to discover why they, who were really not one whit less sensible persons than our excellent selves, should have been led to entertain views which strike us as absurd, The belief in what is erroneously called spontaneous generation, that is to say, in the development of living matter out of mineral matter, apart from the agency of pre-existing living matter, as an ordinary occurrence at the present day–which is still held by some of us, was universally accepted as an obvious truth by them. They could point to the arborescent forms assumed by hoar-frost and by sundry metallic minerals as evidence of the existence in nature of a "plastic force" competent to enable inorganic matter to assume the form of organised bodies. Then, as every one who is familiar with fossils knows, they present innumerable gradations, from shells and bones which exactly resemble the recent objects, to masses of mere stone which, however accurately they repeat the outward form of the organic body, have nothing else in common with it; and, thence, to mere traces and faint impressions in the continuous substance of the rock. What we now know to be the results of the chemical changes which take place in the course of fossilisation, by which mineral is substituted for organic substance, might, in the absence of such knowledge, be fairly interpreted [29] as the expression of a process of development in the opposite direction–from the mineral to the organic. Moreover, in an age when it would have seemed the most absurd of paradoxes to suggest that the general level of the sea is constant, while that of the solid land fluctuates up and down through thousands of feet in a secular ground swell, it may well have appeared far less hazardous to conceive that fossils are sports of nature than to accept the necessary alternative, that all the inland regions and highlands, in the rocks of which marine shells had been found, had once been covered by the ocean. It is not so surprising, therefore, as it may at first seem, that although such men as Leonardo da Vinci and Bernard Palissy took just views of the nature of fossils, the opinion of the majority of their contemporaries set strongly the other way; nor even that error maintained itself long after the scientific grounds of the true interpretation of fossils had been stated, in a manner that left nothing to be desired, in the latter half of the seventeenth century. The person who rendered this good service to palæontology was Nicolas Steno, professor of anatomy in Florence, though a Dane by birth. Collectors of fossils at that day were familiar with certain bodies termed "glossopetræ,"

and speculation was rife as to their nature. In the first half of the seventeenth century, Fabio Colonna had tried to convince his colleagues of [30] the famous Accademia dei Lincei that the glossopetræ were merely fossil sharks' teeth, but his arguments made no impression. Fifty years later, Steno re-opened the question, and, by dissecting the head of a shark and pointing out the very exact correspondence of its teeth with the glossopetræ, left no rational doubt as to the origin of the latter. Thus far, the work of Steno went little further than that of Colonna, but it fortunately occurred to him to think out the whole subject of the interpretation of fossils, and the result of his meditations was the publication, in 1669, of a little treatise with the very quaint title of "De Solido intra Solidum naturaliter contento." The general course of Steno's argument may be stated in a few words. Fossils are solid bodies which, by some natural process, have come to be contained within other solid bodies, namely, the rocks in which they are embedded; and the fundamental problem of palæontology, stated generally, is this: "Given a body endowed with a certain shape and produced in accordance with natural laws, to find in that body itself the evidence of the place and manner of its production."[1] The only way of solving this problem is by the application of the axiom that "like effects imply like causes," or as Steno puts it, in [31] reference to this particular case, that "bodies which are altogether similar have been produced in the same way."[2] Hence, since the glossopetræ are altogether similar to sharks' teeth, they must have been produced by sharklike fishes; and since many fossil shells correspond, down to the minutest details of structure, with the shells of existing marine or freshwater animals, they must have been produced by similar animals; and the like reasoning is applied by Steno to the fossil bones of vertebrated animals, whether aquatic or terrestrial. To the obvious objection that many fossils are not altogether similar to their living analogues, differing in substance while agreeing in form, or being mere hollows or impressions, the surfaces of which are figured in the same way as those of animal or vegetable organisms, Steno replies by pointing out the changes which take place in organic remains embedded in the earth, and how their solid substance may be dissolved away entirely, or replaced by mineral matter, until nothing is left of the original but a cast, an impression, or a mere trace of its contours. The principles of investigation thus excellently stated and illustrated by Steno in 1669, are those which have, consciously or unconsciously, guided the researches of palæontologists ever since. Even that feat of palæontology which has so powerfully [32] impressed the popular imagination, the reconstruction of an extinct animal from a tooth or a bone, is based upon the simplest imaginable application of the logic of Steno. A moment's consideration will show, in fact, that Steno's conclusion that the glossopetræ are sharks' teeth implies the reconstruction of an animal from its tooth. It is equivalent to the assertion that the animal of which the glossopetræ are relics had the form and organisation of a shark; that it had a skull, a vertebral column, and limbs similar to those which are characteristic of this group of fishes; that its heart, gills, and intestines presented the peculiarities which those of all sharks exhibit; nay, even that any hard parts which its integument contained were of a totally different character from the scales of ordinary fishes. These conclusions are as certain as any based upon probable reasonings can be. And they are so, simply because a very large experience justifies us in believing that teeth of this particular form and structure are invariably associated with the peculiar organisation of sharks, and are never found in connection with other organisms. Why this should be we are not at present in a position even to imagine; we must take the fact as an empirical law of animal morphology, the reason of which may possibly be one day found in the history of the evolution of the shark tribe, but for which it is hopeless to seek for an explanation in ordinary [33] physiological reasonings. Every one practically acquainted with palæontology is aware that it is not

every tooth, nor every bone, which enables us to form a judgment of the character of the animal to which it belonged; and that it is possible to possess many teeth, and even a large portion of the skeleton of an extinct animal, and yet be unable to reconstruct its skull or its limbs. It is only when the tooth or bone presents peculiarities, which we know by previous experience to be characteristic of a certain group, that we can safely predict that the fossil belonged to an animal of the same group. Any one who finds a cow's grinder may be perfectly sure that it belonged to an animal which had two complete toes on each foot and ruminated; any one who finds a horse's grinder may be as sure that it had one complete toe on each foot and did not ruminate; but if ruminants and horses were extinct animals of which nothing but the grinders had ever been discovered, no amount of physiological reasoning could have enabled us to reconstruct either animal, still less to have divined the wide differences between the two. Cuvier, in the "Discours sur les Révolutions de la Surface du Globe," strangely credits himself, and has ever since been credited by others, with the invention of a new method of palæontological research. But if you will turn to the "Recherches sur les Ossemens Fossiles" and watch Cuvier, not speculating, but [34] working, you will find that his method is neither more nor less than that of Steno. If he was able to make his famous prophecy from the jaw which lay upon the surface of a block of stone to the pelvis of the same animal which lay hidden in it, it was not because either he, or any one else, knew, or knows, why a certain form of jaw is, as a rule, constantly accompanied by the presence of marsupial bones, but simply because experience has shown that these two structures are coordinated.

The settlement of the nature of fossils led at once to the next advance of palæontology, viz. its application to the deciphering of the history of the earth. When it was admitted that fossils are remains of animals and plants, it followed that, in so far as they resemble terrestrial, or freshwater, animals and plants, they are evidences of the existence of land, or fresh water; and, in so far as they resemble marine organisms, they are evidences of the existence of the sea at the time at which they were parts of actually living animals and plants. Moreover, in the absence of evidence to the contrary, it must be admitted that the terrestrial or the marine organisms implied the existence of land or sea at the place in which they were found while they were yet living. In fact, such conclusions were immediately drawn by everybody, from the time of Xenophanes downwards, who believed that fossils were really [35] organic remains. Steno discusses their value as evidence of repeated alteration of marine and terrestrial conditions upon the soil of Tuscany in a manner worthy of a modern geologist. The speculations of De Maillet in the beginning of the eighteenth century turn upon fossils; and Buffon follows him very closely in those two remarkable works, the "Théorie de la Terre" and the "époques de la Nature" with which he commenced and ended his career as a naturalist.

The opening sentences of the "époques de la Nature" show us how fully Buffon recognised the analogy of geological with archæological inquiries. "As in civil history we consult deeds, seek for coins, or decipher antique inscriptions in order to determine the epochs of human revolutions and fix the date of moral events; so, in natural history, we must search the archives of the world, recover old monuments from the bowels of the earth, collect their fragmentary remains, and gather into one body of evidence all the signs of physical change which may enable us to look back upon the different ages of nature. It is our only means of fixing some points in the immensity of space, and of setting a certain number of waymarks along the eternal path of time."

Buffon enumerates five classes of these monuments of the past history of the earth, and they are all facts of palæontology. In the first place, he says, shells and other marine productions [36] are found all over the surface and in the interior of the dry land; and all calcareous rocks are made up of their remains. Secondly, a great many of these shells which are found in Europe are not now to be met with in the adjacent seas; and, in the slates and other deep-seated deposits, there are remains of fishes and of plants of which no species now exist in our latitudes, and which are either extinct, or exist only in more northern climates. Thirdly, in Siberia and in other northern regions of Europe and of Asia, bones and teeth of elephants, rhinoceroses, and hippopotamuses occur in such numbers that these animals must once have lived and multiplied in those regions, although at the present day they are confined to southern climates. The deposits in which these remains are found are superficial, while those which contain shells and other marine remains lie much deeper. Fourthly, tusks and bones of elephants and hippopotamuses are found not only in the northern regions of the old world, but also in those of the new world, although, at present, neither elephants nor hippopotamuses occur in America. Fifthly, in the middle of the continents, in regions most remote from the sea, we find an infinite number of shells, of which the most part belong to animals of those kinds which still exist in southern seas, but of which many others have no living analogues; so that these species appear to be lost, destroyed by some unknown [37] cause. It is needless to inquire how far these statements are strictly accurate; they are sufficiently so to justify Buffon's conclusions that the dry land was once beneath the sea; that the formation of the fossiliferous rocks must have occupied a vastly greater lapse of time than that traditionally ascribed to the age of the earth; that fossil remains indicate different climatal conditions to have obtained in former times, and especially that the polar regions were once warmer; that many species of animals and plants have become extinct; and that geological change has had something to do with geographical distribution.

But these propositions almost constitute the frame-work of palæontology. In order to complete it but one addition was needed, and that was made, in the last years of the eighteenth century, by William Smith, whose work comes so near our own times that many living men may have been personally acquainted with him. This modest land-surveyor, whose business took him into many parts of England, profited by the peculiarly favourable conditions offered by the arrangement of our secondary strata to make a careful examination and comparison of their fossil contents at different points of the large area over which they extend. The result of his accurate and widely-extended observations was to establish the important truth that each stratum [38] contains certain fossils which are peculiar to it; and that the order in which the strata, characterised by these fossils, are super-imposed one upon the other is always the same. This most important generalisation was rapidly verified and extended to all parts of the world accessible to geologists; and now it rests upon such an immense mass of observations as to be one of the best established truths of natural science. To the geologist the discovery was of infinite importance as it enabled him to identify rocks of the same relative age, however their continuity might be interrupted or their composition altered. But to the biologist it had a still deeper meaning, for it demonstrated that, throughout the prodigious duration of time registered by the fossiliferous rocks, the living population of the earth had undergone continual changes, not merely by the extinction of a certain number of the species which had at first existed, but by the continual generation of new species, and the no less constant extinction of old ones.

Thus the broad outlines of palæontology, in so far as it is the common property of both the geologist and the biologist, were marked out at the close of the last century. In tracing its subsequent progress I must confine myself to the province of biology, and, indeed, to the influence of palæontology upon zoological morphology. And I accept this limitation the more willingly as the [39] no less important topic of the bearing of geology and of palæontology upon distribution has been luminously treated in the address of the President of the Geographical Section.[3]

The succession of the species of animals and plants in time being established, the first question which the zoologist or the botanist had to ask himself was, What is the relation of these successive species one to another? And it is a curious circumstance that the most important event in the history of palæontology which immediately succeeded William Smith's generalisation was a discovery which, could it have been rightly appreciated at the time, would have gone far towards suggesting the answer, which was in fact delayed for more than half a century. I refer to Cuvier's investigation of the mammalian fossils yielded by the quarries in the older tertiary rocks of Montmartre, among the chief results of which was the bringing to light of two genera of extinct hoofed quadrupeds, the *Anoplotherium* and the *Palæotherium.* The rich materials at Cuvier's disposition enabled him to obtain a full knowledge of the osteology and of the dentition of these two forms, and consequently to compare their structure critically with that of existing hoofed animals. The effect of this comparison was to prove that the *Anoplotherium*, though it presented many points of resemblance with the pigs on the one [40] hand and with the ruminants on the other, differed from both to such an extent that it could find a place in neither group. In fact, it held, in some respects, an intermediate position, tending to bridge over the interval between these two groups, which in the existing fauna are so distinct. In the same way, the *Palæotherium* tended to connect forms so different as the tapir, the rhinoceros, and the horse. Subsequent investigations have brought to light a variety of facts of the same order, the most curious and striking of which are those which prove the existence, in the mesozoic epoch, of a series of forms intermediate between birds and reptiles–two classes of vertebrate animals which at present appear to be more widely separated than any others. Yet the interval between them is completely filled, in the mesozoic fauna, by birds which have reptilian characters, on the one side, and reptiles which have ornithic characters, on the other. So again, while the group of fishes, termed ganoids, is, at the present time, so distinct from that of the dipnoi, or mudfishes, that they have been reckoned as distinct orders, the Devonian strata present us with forms of which it is impossible to say with certainty whether they are dipnoi or whether they are ganoids.

Agassiz's long and elaborate researches upon fossil fishes, published between 1833 and 1842, led him to suggest the existence of another kind of relation between ancient and modern forms of [41] life. He observed that the oldest fishes present many characters which recall the embryonic conditions of existing fishes; and that, not only among fishes, but in several groups of the invertebrata which have a long palæontological history, the latest forms are more modified, more specialised, than the earlier. The fact that the dentition of the older tertiary ungulate and carnivorous mammals is always complete, noticed by Professor Owen, illustrated the same generalisation.

Another no less suggestive observation was made by Mr. Darwin, whose personal investigations during the voyage of the *Beagle* led him to remark upon the singular fact, that the fauna, which immediately

precedes that at present existing in any geographical province of distribution, presents the same peculiarities as its successor. Thus, in South America and in Australia, the later tertiary or quaternary fossils show that the fauna which immediately preceded that of the present day was, in the one case, as much characterised by edentates and, in the other, by marsupials as it is now, although the species of the older are largely different from those of the newer fauna.

However clearly these indications might point in one direction, the question of the exact relation of the successive forms of animal and vegetable life could be satisfactorily settled only in one way; namely, by comparing, stage by stage, the series of forms presented by one and the same type through[42]out a long space of time. Within the last few years this has been done fully in the case of the horse, less completely in the case of the other principal types of the ungulata and of the carnivora; and all these investigations tend to one general result, namely, that, in any given series, the successive members of that series present a gradually increasing specialisation of structure. That is to say, if any such mammal at present existing has specially modified and reduced limbs or dentition and complicated brain, its predecessors in time show less and less modification and reduction in limbs and teeth and a less highly developed brain. The labours of Gaudry, Marsh, and Cope furnish abundant illustrations of this law from the marvellous fossil wealth of Pikermi and the vast uninterrupted series of tertiary rocks in the territories of North America.

I will now sum up the results of this sketch of the rise and progress of palæontology. The whole fabric of palæontology is based upon two propositions: the first is, that fossils are the remains of animals and plants; and the second is, that the stratified rocks in which they are found are sedimentary deposits; and each of these propositions is founded upon the same axiom, that like effects imply like causes. If there is any cause competent to produce a fossil stem, or shell, or bone, except a living being, then palæontology has no founda[43]tion; if the stratification of the rocks is not the effect of such causes as at present produce stratification, we have no means of judging of the duration of past time, or of the order in which the forms of life have succeeded one another. But if these two propositions are granted, there is no escape, as it appears to me, from three very important conclusions. The first is that living matter has existed upon the earth for a vast length of time, certainly for millions of years. The second is that, during this lapse of time, the forms of living matter have undergone repeated changes, the effect of which has been that the animal and vegetable population, at any period of the earth's history, contains certain species which did not exist at some antecedent period, and others which ceased to exist at some subsequent period. The third is that, in the case of many groups of mammals and some of reptiles, in which one type can be followed through a considerable extent of geological time, the series of different forms by which the type is represented, at successive intervals of this time, is exactly such as it would be, if they had been produced by the gradual modification of the earliest forms of the series. These are facts of the history of the earth guaranteed by as good evidence as any facts in civil history.

Hitherto I have kept carefully clear of all the hypotheses to which men have at various times endeavoured to fit the facts of palæontology, or by [44] which they have endeavoured to connect as many of these facts as they happened to be acquainted with. I do not think it would be a profitable employment of our time to discuss conceptions which doubtless have had their justification and even their use, but which are now obviously incompatible with the well-ascertained truths of palæontology.

At present these truths leave room for only two hypotheses. The first is that, in the course of the history of the earth, innumerable species of animals and plants have come into existence, independently of one another, innumerable times. This, of course, implies either that spontaneous generation on the most astounding scale, and of animals such as horses and elephants, has been going on, as a natural process, through all the time recorded by the fossiliferous rocks; or it necessitates the belief in innumerable acts of creation repeated innumerable times. The other hypothesis is, that the successive species of animals and plants have arisen, the later by the gradual modification of the earlier. This is the hypothesis of evolution; and the palæontological discoveries of the last decade are so completely in accordance with the requirements of this hypothesis that, if it had not existed, the palæontologist would have had to invent it.

I have always had a certain horror of presuming to set a limit upon the possibilities of things. Therefore I will not venture to say that it is impossible that the multitudinous species of animals [45] and plants may have been produced, one separately from the other, by spontaneous generation; nor that it is impossible that they should have been independently originated by an endless succession of miraculous creative acts. But I must confess that both these hypotheses strike me as so astoundingly improbable, so devoid of a shred of either scientific or traditional support, that even if there were no other evidence than that of palæontology in its favour, I should feel compelled to adopt the hypothesis of evolution. Happily, the future of palæontology is independent of all hypothetical considerations. Fifty years hence, whoever undertakes to record the progress of palæontology will note the present time as the epoch in which the law of succession of the forms of the higher animals was determined by the observation of palæontological facts. He will point out that, just as Steno and as Cuvier were enabled from their knowledge of the empirical laws of co-existence of the parts of animals to conclude from a part to the whole, so the knowledge of the law of succession of forms empowered their successors to conclude, from one or two terms of such a succession, to the whole series; and thus to divine the existence of forms of life, of which, perhaps, no trace remains, at epochs of inconceivable remoteness in the past.

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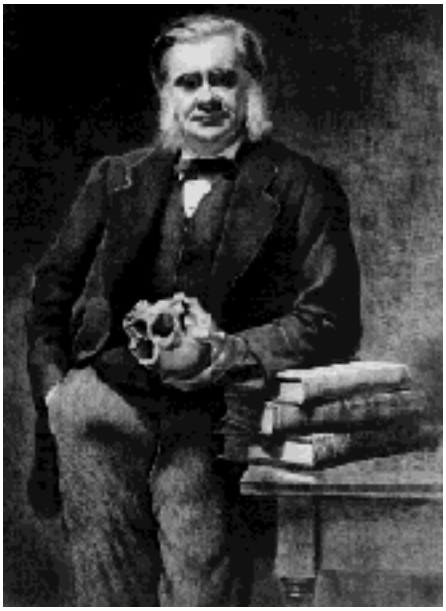
[1] *De Solidoiintra Solidum,* p.5–"Dato corpore certâ figurâ prædito et juxta leges naturæ producto, in ipso corpore argumenta invenire locum et modum productionis detegentia."

[2] "Corpora sibi invicem omnino similia simili etiam modo producta sunt."

[3] Sir J. D. Hooker.

THE HUXLEY FILE



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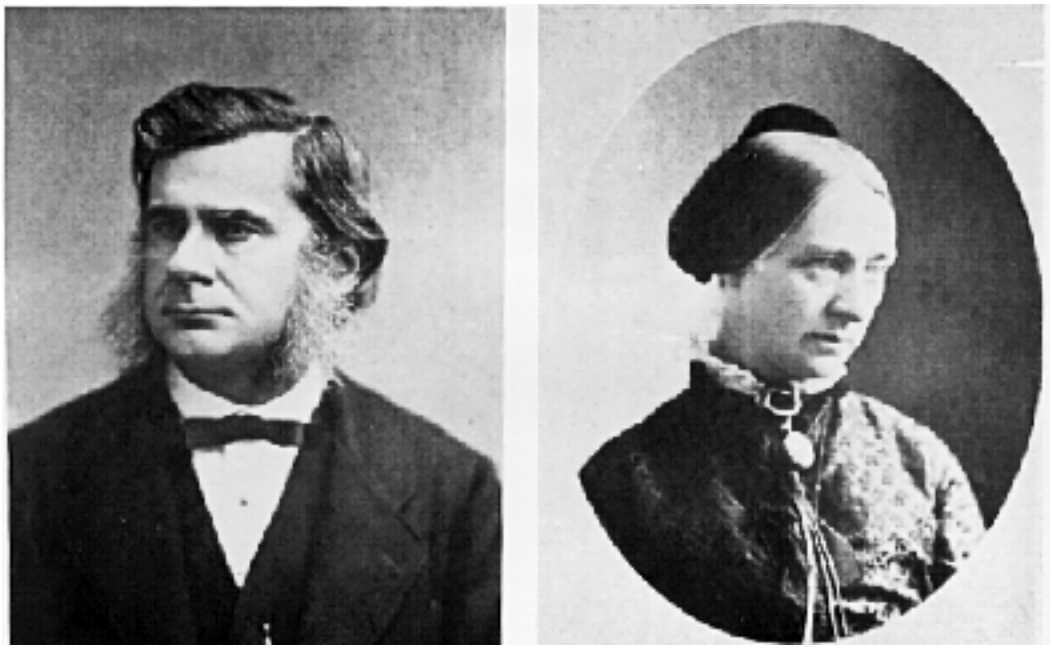


Mr. and Mrs. Huxley 1876

Huxley Archives

Lectures on Evolution (1877)

Collected Essays IV

I

THE THREE HYPOTHESES RESPECTING THE HISTORY OF NATURE

[46] We live in and form part of a system of things of immense diversity and perplexity, which we call Nature; and it is a matter of the deepest interest to all of us that we should form just conceptions of the constitution of that system and of its past history. With relation to this universe, man is, in extent, little more than a mathematical point; in duration but a fleeting shadow; he is a mere reed shaken in the winds of force. But as Pascal long ago remarked, although a mere reed, he is a thinking reed; and in virtue of that wonderful capacity of thought, he has the power of framing for himself a symbolic conception of the universe, [47] which, although doubtless highly imperfect and inadequate as a picture of the great whole, is yet sufficient to serve him as a chart for the guidance of his practical affairs. It has taken long ages of toilsome and often fruitless labour to enable man to look steadily at the shifting scenes of the phantasmagoria of Nature, to notice what is fixed among her fluctuations, and what is regular among her apparent irregularities; and it is only comparatively lately, within the last few centuries, that the conception of a universal order and of a definite course of things, which we term the course of Nature, has emerged.

But, once originated, the conception of the constancy of the order of Nature has become the dominant

idea of modern thought. To any person who is familiar with the facts upon which that conception is based, and is competent to estimate their significance, it has ceased to be conceivable that chance should have any place in the universe, or that events should depend upon any but the natural sequence of cause and effect. We have come to look upon the present as the child of the past and as the parent of the future; and, as we have excluded chance from a place in the universe, so we ignore, even as a possibility, the notion of any interference with the order of Nature. Whatever may be men's speculative doctrines, it is quite certain that every intelligent person guides his life and risks his fortune upon the belief that the order [48] of Nature is constant, and that the chain of natural causation is never broken.

In fact, no belief which we entertain has so complete a logical basis as that to which I have just referred. It tacitly underlies every process of reasoning; it is the foundation of every act of the will. It is based upon the broadest induction, and it is verified by the most constant, regular, and universal of deductive processes. But we must recollect that any human belief, however broad its basis, however defensible it may seem, is, after all, only a probable belief, and that our widest and safest generalisations are simply statements of the highest degree of probability. Though we are quite clear about the constancy of the order of Nature, at the present time, and in the present state of things, it by no means necessarily follows that we are justified in expanding this generalisation into the infinite past, and in denying, absolutely, that there may have been a time when Nature did not follow a fixed order, when the relations of cause and effect were not definite, and when extra-natural agencies interfered with the general course of Nature. Cautious men will allow that a universe so different from that which we know may have existed; just as a very candid thinker may admit that a world in which two and two do not make four, and in which two straight lines do inclose a space, may exist. But the same caution which forces the admission of [49] such possibilities demands a great deal of evidence before it recognises them to be anything more substantial. And when it is asserted that, so many thousand years ago, events occurred in a manner utterly foreign to and inconsistent with the existing laws of Nature, men, who without being particularly cautious, are simply honest thinkers, unwilling to deceive themselves or delude others, ask for trustworthy evidence of the fact.

Did things so happen or did they not? This is a historical question, and one the answer to which must be sought in the same way as the solution of any other historical problem.

So far as I know, there are only three hypotheses which ever have been entertained, or which well can be entertained, respecting the past history of Nature. I will, in the first place, state the hypotheses, and then I will consider what evidence bearing upon them is in our possession, and by what light of criticism that evidence is to be interpreted.

Upon the first hypothesis, the assumption is, that phenomena of Nature similar to those exhibited by the present world have always existed; in other words, that the universe has existed, from all eternity, in what may be broadly termed its present condition.

The second hypothesis is that the present state [50] of things has had only a limited duration; and that, at some period in the past, a condition of the world, essentially similar to that which we now know, came

into existence, without any precedent condition from which it could have naturally proceeded. The assumption that successive states of Nature have arisen, each without any relation of natural causation to an antecedent state, is a mere modification of this second hypothesis.

The third hypothesis also assumes that the present state of things has had but a limited duration; but it supposes that this state has been evolved by a natural process from an antecedent state, and that from another, and so on; and, on this hypothesis, the attempt to assign any limit to the series of past changes is, usually, given up.

It is so needful to form clear and distinct notions of what is really meant by each of these hypotheses that I will ask you to imagine what, according to each, would have been visible to a spectator of the events which constitute the history of the earth. On the first hypothesis, however far back in time that spectator might be placed, he would see a world essentially, though perhaps not in all its details, similar to that which now exists. The animals which existed would be the ancestors of those which now live, and similar to them; the plants, in like manner, would be such as we know; and the mountains, plains, and waters would foreshadow the salient features of our present land [51] and water. This view was held more or less distinctly, sometimes combined with the notion of recurrent cycles of change, in ancient times; and its influence has been felt down to the present day. It is worthy of remark that it is a hypothesis which is not inconsistent with the doctrine of Uniformitarianism, with which geologists are familiar. That doctrine was held by Hutton, and in his earlier days by Lyell. Hutton was struck by the demonstration of astronomers that the perturbations of the planetary bodies, however great they may be, yet sooner or later right themselves; and that the solar system possesses a self-adjusting power by which these aberrations are all brought back to a mean condition. Hutton imagined that the like might be true of terrestrial changes; although no one recognised more clearly than he the fact that the dry land is being constantly washed down by rain and rivers and deposited in the sea; and that thus, in a longer or shorter time, the inequalities of the earth's surface must be levelled, and its high lands brought down to the ocean. But, taking into account the internal forces of the earth, which, upheaving the sea-bottom give rise to new land, he thought that these operations of degradation and elevation might compensate each other; and that thus, for any assignable time, the general features of our planet might remain what they are. And inasmuch as, under these circumstances, there need be no limit to the [52] propagation of animals and plants, it is clear that the consistent working out of the uniformitarian idea might lead to the conception of the eternity of the world. Not that I mean to say that either Hutton or Lyell held this conception–assuredly not; they would have been the first to repudiate it. Nevertheless, the logical development of some of their arguments tends directly towards this hypothesis.

The second hypothesis supposes that the present order of things, at some no very remote time, had a sudden origin, and that the world, such as it now is, had chaos for its phenomenal antecedent. That is the doctrine which you will find stated most fully and clearly in the immortal poem of John Milton–the English *Divina Commedia*– "Paradise Lost." I believe it is largely to the influence of that remarkable work, combined with the daily teachings to which we have all listened in our childhood, that this hypothesis owes its general wide diffusion as one of the current beliefs of English-speaking people. If you turn to the seventh book of "Paradise Lost," you will find there stated the hypothesis to which I refer, which is briefly this: That this visible universe of ours came into existence at no great distance of

time from the present; and that the parts of which it is composed made their appearance, in a certain definite order, in the space of six natural days, in such a manner that, on the first of these days, [53] light appeared; that, on the second, the firmament, or sky, separated the waters above, from the waters beneath the firmament; that, on the third day, the waters drew away from the dry land, and upon it a varied vegetable life, similar to that which now exists, made its appearance; that the fourth day was signalised by the apparition of the sun, the stars, the moon, and the planets; that, on the fifth day, aquatic animals originated within the waters; that, on the sixth day, the earth gave rise to our four-footed terrestrial creatures, and to all varieties of terrestrial animals except birds, which had appeared on the preceding day; and, finally, that man appeared upon the earth, and the emergence of the universe from chaos was finished. Milton tells us, without the least ambiguity, what a spectator of these marvellous occurrences would have witnessed. I doubt not that his poem is familiar to all of you, but I should like to recall one passage to your minds, in order that I may be justified in what I have said regarding the perfectly concrete, definite, picture of the origin of the animal world which Milton draws. He says:–

"The sixth, and of creation last, arose
With evening harp and matin, when God said,
'Let the earth bring forth soul living in her kind,
Cattle and creeping things, and beast of the earth.
Each in their kind!' The earth obeyed, and, straight
Opening her fertile womb, teemed at a birth
Innumerous living creatures, perfect forms,
[54] Limbed and full-grown. Out of the ground uprose,
As from his lair, the wild beast, where he wons
In forest wild, in thicket, brake, or den;
mong the trees in pairs they rose, they walked;
The cattle in the fields and meadows green;
Those rare and solitary; these in flocks
Pasturing at once, and in broad herds upsprung.
The grassy clods now calved; now half appears
The tawny lion, pawing to get free
His hinder parts–then springs, as broke from bonds,
And rampant shakes his brinded mane; the ounce,
The libbard, and the tiger, as the mole
Rising, the crumbled earth above them threw
In hillocks; the swift stag from underground
Bore up his branching head; scarce from his mould
Behemoth, biggest born of earth, upheaved
His vastness; fleeced the flocks and bleating rose
As plants; ambiguous between sea and land,
The river-horse and scaly crocodile.
At once came forth whatever creeps the ground,
Insect or worm. "

There is no doubt as to the meaning of this statement, nor as to what a man of Milton's genius expected would have been actually visible to an eye-witness of this mode of origination of living things.

The third hypothesis, or the hypothesis of evolution, supposes that, at any comparatively late period of past time, our imaginary spectator would meet with a state of things very similar to that which now obtains; but that the likeness of the past to the present would gradually become less and less, in proportion to the remoteness of his period of observation from the present day; that [55] the existing distribution of mountains and plains, of rivers and seas, would show itself to be the product of a slow process of natural change operating upon more and more widely different antecedent conditions of the mineral frame-work of the earth; until, at length, in place of that frame-work, he would behold only a vast nebulous mass, representing the constituents of the sun and of the planetary bodies. Preceding the forms of life which now exist, our observer would see animals and plants, not identical with them, but like them, increasing their differences with their antiquity and, at the same time, becoming simpler and simpler; until, finally, the world of life would present nothing but that undifferentiated protoplasmic matter which, so far as our present knowledge goes, is the common foundation of all vital activity.

The hypothesis of evolution supposes that in all this vast progression there would be no breach of continuity, no point at which we could say "This is a natural process," and "This is not a natural process;" but that the whole might be compared to that wonderful operation of development which may be seen going on every day under our eyes, in virtue of which there arises, out of the semi-fluid comparatively homogeneous substance which we call an egg, the complicated organisation of one of the higher animals. That, in a few words, is what is meant by the hypothesis of evolution.

[56] I have already suggested that, in dealing with these three hypotheses, in endeavouring to form a judgment as to which of them is the more worthy of belief, or whether none is worthy of belief–in which case our condition of mind should be that suspension of judgment which is so difficult to all but trained intellects–we should be indifferent to all *a priori* considerations. The question is a question of historical fact. The universe has come into existence somehow or other, and the problem is, whether it came into existence in one fashion, or whether it came into existence in another; and, as an essential preliminary to further discussion, permit me to say two or three words as to the nature and the kinds of historical evidence.

The evidence as to the occurrence of any event in past time may be ranged under two heads which, for convenience' sake, I will speak of as testimonial evidence and as circumstantial evidence. By testimonial evidence I mean human testimony; and by circumstantial evidence I mean evidence which is not human testimony. Let me illustrate by a familiar example what I understand by these two kinds of evidence, and what is to be said respecting their value.

Suppose that a man tells you that he saw a person strike another and kill him; that is testimonial evidence of the fact of murder. But it is possible to have circumstantial evidence of the fact of murder; that is to say, you may find a [57] man dying with a wound upon his head having exactly the form and character of the wound which is made by an axe, and, with due care in taking surrounding circumstances into account, you may conclude with the utmost certainty that the man has been murdered; that his death is the consequence of a blow inflicted by another man with that implement. We are very much in the habit of considering circumstantial evidence as of less value than testimonial evidence, and it may be

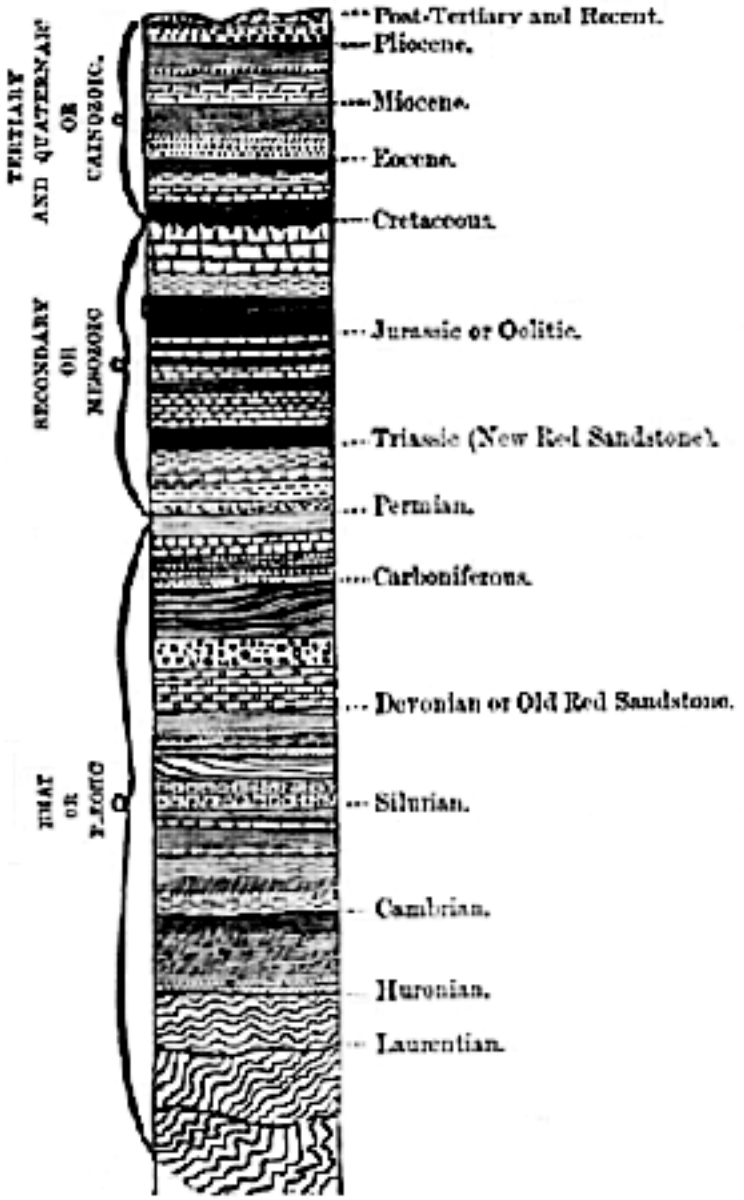
that, where the circumstances are not perfectly clear and intelligible, it is a dangerous and unsafe kind of evidence; but it must not be forgotten that, in many cases, circumstantial is quite as conclusive as testimonial evidence, and that, not unfrequently, it is a great deal weightier than testimonial evidence. For example, take the case to which I referred just now. The circumstantial evidence may be better and more convincing than the testimonial evidence; for it may be impossible, under the conditions that I have defined, to suppose that the man met his death from any cause but the violent blow of an axe wielded by another man. The circumstantial evidence in favour of a murder having been committed, in that case, is as complete and as convincing as evidence can be. It is evidence which is open to no doubt and to no falsification. But the testimony of a witness is open to multitudinous doubts. He may have been mistaken. He [58] may have been actuated by malice. It has constantly happened that even an accurate man has declared that a thing has happened in this, that, or the other way, when a careful analysis of the circumstantial evidence has shown that it did not happen in that way, but in some other way.

We may now consider the evidence in favour of or against the three hypotheses. Let me first direct your attention to what is to be said about the hypothesis of the eternity of the state of things in which we now live. What will first strike you is, that it is a hypothesis which, whether true or false, is not capable of verification by any evidence. For, in order to obtain either circumstantial or testimonial evidence sufficient to prove the eternity of duration of the present state of nature, you must have an eternity of witnesses or an infinity of circumstances, and neither of these is attainable. It is utterly impossible that such evidence should be carried beyond a certain point of time; and all that could be said, at most, would be, that so far as the evidence could be traced, there was nothing to contradict the hypothesis. But when you look, not to the testimonial evidence–which, considering the relative insignificance of the antiquity of human records, might not be good for much in this case–but to the circumstantial evidence, then you find that this hypothesis is absolutely incompatible with such evidence as we have; [59] which is of so plain and so simple a character that it is impossible in any way to escape from the conclusions which it forces upon us.

You are, doubtless, all aware that the outer substance of the earth, which alone is accessible to direct observation, is not of a homogeneous character, but that it is made up of a number of layers or strata, the titles of the principal groups of which are placed upon the accompanying diagram. Each of these groups represents a number of beds of sand, of stone, of clay, of slate, and of various other materials.

On careful examination, it is found that the materials of which each of these layers of more or less hard rock are composed are, for the most part, of the same nature as those which are at present being formed under known conditions on the surface of the earth. For example, the chalk, which constitutes a great part of the Cretaceous formation in some parts of the world, is practically identical in its physical and chemical characters with a substance which is now being formed at the bottom of the Atlantic Ocean, and covers an enormous area; other beds of rock are comparable with the sands which are being formed upon sea-shores, packed together, and so on. Thus, omitting rocks of igneous origin, it is demonstrable that all these beds of stone, of which a total of not less than seventy thousand feet is known, have been formed by natural [61] agencies, either out of the waste and washing of the dry land, or else by the accumulation of the exuviæ of plants and animals. Many of these strata are full of such exuviæ–the so-

called "fossils." Remains of thousands of species of animals and plants, as perfectly recognisable as those of existing forms of life which you meet with in museums, or as the shells which you pick up upon the sea-beach, have been imbedded in the ancient sands, or muds, or limestones, just as they are being imbedded now, in sandy, or clayey, or calcareous subaqueous deposits. They furnish us with a record, the general nature of which cannot be misinterpreted, of the kinds of things that have lived upon the surface of the earth during the time that is registered by this great thickness of stratified rocks. But even a superficial study of these fossils shows us that the animals and plants which live at the present time have had only a temporary duration; for the remains of such modern forms of life are met with, for the most part, only in the uppermost or latest tertiaries, and their number rapidly diminishes in the lower deposits of that epoch. In the older tertiaries, the places of existing animals and plants are taken by other forms, as numerous and diversified as those which live now in the same localities, but more or less different from them; in the mesozoic rocks, these are replaced by others yet more divergent from modern types; and, in the paleozoic formations, the [62] contrast is still more marked. Thus the circumstantial evidence absolutely negatives the conception of the eternity of the present condition of things. We can say, with certainty, that the present condition of things has existed for a comparatively short period; and that, so far as animal and vegetable nature are concerned, it has been preceded by a different condition. We can pursue this evidence until we reach the lowest of the stratified rocks, in which we lose the indications of life altogether. The hypothesis of the eternity of the present state of nature may therefore be put out of court.



[60] Fig. 1.–Ideal Section of the Crust of the Earth.

We now come to what I will term Milton's hypothesis–the hypothesis that the present condition of things has endured for a comparatively short time; and, at the commencement of that time, came into existence within the course of six days. I doubt not that it may have excited some surprise in your minds that I should have spoken of this as Milton's hypothesis, rather than that I should have chosen the terms which are more customary, such as "the doctrine of creation," or "the Biblical doctrine," or "the doctrine of Moses," all of which denominations, as applied to the hypothesis to which I have just referred, are certainly much more familiar to you than the title of the Miltonic hypothesis. But I have had what I

cannot but think are very weighty reasons for taking the course which I have pursued. In [63] the first place, I have discarded the title of the "doctrine of creation," because my present business is not with the question why the objects which constitute Nature came into existence, but when they came into existence, and in what order. This is as strictly a historical question as the question when the Angles and the Jutes invaded England, and whether they preceded or followed the Romans. But the question about creation is a philosophical problem, and one which cannot be solved, or even approached, by the historical method. What we want to learn is, whether the facts, so far as they are known, afford evidence that things arose in the way described by Milton, or whether they do not; and, when that question is settled it will be time enough to inquire into the causes of their origination.

In the second place, I have not spoken of this doctrine as the Biblical doctrine. It is quite true that persons as diverse in their general views as Milton the Protestant and the celebrated Jesuit Father Suarez, each put upon the first chapter of Genesis the interpretation embodied in Milton's poem. It is quite true that this interpretation is that which has been instilled into every one of us in our childhood; but I do not for one moment venture to say that it can properly be called the Biblical doctrine. It is not my business, and does not lie within my competency, to say what the Hebrew text does, and what it does not [64] signify; moreover, were I to affirm that this is the Biblical doctrine, I should be met by the authority of many eminent scholars, to say nothing of men of science, who, at various times, have absolutely denied that any such doctrine is to be found in Genesis. If we are to listen to many expositors of no mean authority, we must believe that what seems so clearly defined in Genesis–as if very great pains had been taken that there should be no possibility of mistake–is not the meaning of the text at all. The account is divided into periods that we may make just as long or as short as convenience requires. We are also to understand that it is consistent with the original text to believe that the most complex plants and animals may have been evolved by natural processes, lasting for millions of years, out of structureless rudiments. A person who is not a Hebrew scholar can only stand aside and admire the marvellous flexibility of a language which admits of such diverse interpretations. But assuredly, in the face of such contradictions of authority upon matters respecting which he is incompetent to form any judgment, he will abstain, as I do, from giving any opinion.

In the third place, I have carefully abstained from speaking of this as the Mosaic doctrine, because we are now assured upon the authority of the highest critics and even of dignitaries of the Church, that there is no evidence that Moses [65] wrote the Book of Genesis, or knew anything about it. You will understand that I give no judgment–it would be an impertinence upon my part to volunteer even a suggestion–upon such a subject. But, that being the state of opinion among the scholars and the clergy, it is well for the unlearned in Hebrew lore, and for the laity, to avoid entangling themselves in such a vexed question. Happily, Milton leaves us no excuse for doubting what he means, and I shall therefore be safe in speaking of the opinion in question as the Miltonic hypothesis.

Now we have to test that hypothesis. For my part, I have no prejudice one way or the other. If there is evidence in favour of this view, I am burdened by no theoretical difficulties in the way of accepting it; but there must be evidence. Scientific men get an awkward habit–no, I won't call it that, for it is a valuable habit–of believing nothing unless there is evidence for it; and they have a way of looking upon belief which is not based upon evidence, not only as illogical, but as immoral. We will, if you please,

test this view by the circumstantial evidence alone; for, from what I have said, you will understand that I do not propose to discuss the question of what testimonial evidence is to be adduced in favour of it. If those whose business it is to judge are not at one as to the authenticity of the only evidence of that kind which is offered, nor as to the facts to [66] which it bears witness, the discussion of such evidence is superfluous.

But I may be permitted to regret this necessity of rejecting the testimonial evidence the less, because the examination of the circumstantial evidence leads to the conclusion, not only that it is incompetent to justify the hypothesis, but that, so far as it goes, it is contrary to the hypothesis.

The considerations upon which I base this conclusion are of the simplest possible character. The Miltonic hypothesis contains assertions of a very definite character relating to the succession of living forms. It is stated that plants, for example, made their appearance upon the third day, and not before. And you will understand that what the poet means by plants are such plants as now live, the ancestors, in the ordinary way of propagation of like by like, of the trees and shrubs which flourish in the present world. It must needs be so; for, if they were different, either the existing plants have been the result of a separate origination since that described by Milton, of which we have no record, nor any ground for supposition that such an occurrence has taken place; or else they have arisen by a process of evolution from the original stocks.

In the second place, it is clear that there was no animal life before the fifth day, and that, on the fifth day, aquatic animals and birds appeared. [67] And it is further clear that terrestrial living things, other than birds, made their appearance upon the sixth day and not before. Hence, it follows that, if, in the large mass of circumstantial evidence as to what really has happened in the past history of the globe we find indications of the existence of terrestrial animals, other than birds, at a certain period, it is perfectly certain that all that has taken place, since that time, must be referred to the sixth day.

In the great Carboniferous formation, whence America derives so vast a proportion of her actual and potential wealth, in the beds of coal which have been formed from the vegetation of that period, we find abundant evidence of the existence of terrestrial animals. They have been described, not only by European but by your own naturalists. There are to be found numerous insects allied to our cockroaches. There are to be found spiders and scorpions of large size, the latter so similar to existing scorpions that it requires the practised eye of the naturalist to distinguish them. Inasmuch as these animals can be proved to have been alive in the Carboniferous epoch, it is perfectly clear that, if the Miltonic account is to be accepted, the huge mass of rocks extending from the middle of the Palæozoic formations to the uppermost members of the series, must belong to the day which is termed by Milton the sixth. But, further, it is expressly stated that aquatic [68] animals took their origin on the fifth day, and not before; hence, all formations in which remains of aquatic animals can be proved to exist, and which therefore testify that such animals lived at the time when these formations were in course of deposition, must have been deposited during or since the period which Milton speaks of as the fifth day. But there is absolutely no fossiliferous formation in which the remains of aquatic animals are absent. The oldest fossils in the Silurian rocks are exuviæ of marine animals; and if the view which is entertained by Principal Dawson and Dr. Carpenter respecting the nature of the *Eozoon* be well-founded, aquatic animals existed at a

period as far antecedent to the deposition of the coal as the coal is from us; inasmuch as the *Eozoon* is met with in those Laurentian strata which lie at the bottom of the series of stratified rocks. Hence it follows, plainly enough, that the whole series of stratified rocks, if they are to be brought into harmony with Milton, must be referred to the fifth and sixth days, and that we cannot hope to find the slightest trace of the products of the earlier days in the geological record. When we consider these simple facts, we see how absolutely futile are the attempts that have been made to draw a parallel between the story told by so much of the crust of the earth as is known to us and the story which Milton tells. The whole series of fossiliferous stratified [69] rocks must be referred to the last two days; and neither the Carboniferous, nor any other, formation can afford evidence of the work of the third day.

Not only is there this objection to any attempt to establish a harmony between the Miltonic account and the facts recorded in the fossiliferous rocks, but there is a further difficulty. According to the Miltonic account, the order in which animals should have made their appearance in the stratified rocks would be thus: Fishes, including the great whales, and birds; after them, all varieties of terrestrial animals except birds. Nothing could be further from the facts as we find them; we know of not the slightest evidence of the existence of birds before the Jurassic, or perhaps the Triassic, formation; while terrestrial animals, as we have just seen, occur in the Carboniferous rocks.

If there were any harmony between the Miltonic account and the circumstantial evidence, we ought to have abundant evidence of the existence of birds in the Carboniferous, the Devonian, and the Silurian rocks. I need hardly say that this is not the case, and that not a trace of birds makes its appearance until the far later period which I have mentioned.

And again, if it be true that all varieties of fishes and the great whales, and the like, made their appearance on the fifth day, we ought to find [70] the remains of these animals in the older rocks–in those which were deposited before the Carboniferous epoch. Fishes we do find, in considerable number and variety; but the great whales are absent, and the fishes are not such as now live. Not one solitary species of fish now in existence is to be found in the Devonian or Silurian formations. Hence we are introduced afresh to the dilemma which I have already placed before you: either the animals which came into existence on the fifth day were not such as those which are found at present, are not the direct and immediate ancestors of those which now exist; in which case, either fresh creations of which nothing is said, or a process of evolution, must have occurred; or else the whole story must be given up, as not only devoid of any circumstantial evidence, but contrary to such evidence as exists.

I placed before you in a few words, some little time ago, a statement of the sum and substance of Milton's hypothesis. Let me now try to state as briefly, the effect of the circumstantial evidence bearing upon the past history of the earth which is furnished, without the possibility of mistake, with no chance of error as to its chief features, by the stratified rocks. What we find is, that the great series of formations represents a period of time of which our human chronologies hardly afford us a unit of measure. I will not pretend to say how we ought to estimate this time, in [71] millions or in billions of years. For my purpose, the determination of its absolute duration is wholly unessential. But that the time was enormous there can be no question.

It results from the simplest methods of interpretation, that leaving out of view certain patches of metamorphosed rocks, and certain volcanic products, all that is now dry land has once been at the bottom of the waters. It is perfectly certain that, at a comparatively recent period of the world's history–the Cretaceous epoch–none of the great physical features which at present mark the surface of the globe existed. It is certain that the Rocky Mountains were not. It is certain that the Himalaya Mountains were not. It is certain that the Alps and the Pyrenees had no existence. The evidence is of the plainest possible character and is simply this:–We find raised up on the flanks of these mountains, elevated by the forces of upheaval which have given rise to them, masses of Cretaceous rock which formed the bottom of the sea before those mountains existed. It is therefore clear that the elevatory forces which gave rise to the mountains operated subsequently to the Cretaceous epoch; and that the mountains themselves are largely made up of the materials deposited in the sea which once occupied their place. As we go back in time, we meet with constant alternations of sea and land, of estuary and open ocean; and, [72] in correspondence with these alternations, we observe the changes in the fauna and flora to which I have referred.

But the inspection of these changes gives us no right to believe that there has been any discontinuity in natural processes. There is no trace of general cataclysms, of universal deluges, or sudden destructions of a whole fauna or flora. The appearances which were formerly interpreted in that way have all been shown to be delusive, as our knowledge has increased and as the blanks which formerly appeared to exist between the different formations have been filled up. That there is no absolute break between formation and formation, that there has been no sudden disappearance of all the forms of life and replacement of them by others, but that changes have gone on slowly and gradually, that one type has died out and another has taken its place, and that thus, by insensible degrees, one fauna has been replaced by another, are conclusions strengthened by constantly increasing evidence. So that within the whole of the immense period indicated by the fossiliferous stratified rocks, there is assuredly not the slightest proof of any break in the uniformity of Nature's operations, no indication that events have followed other than a clear and orderly sequence.

That, I say, is the natural and obvious teaching of the circumstantial evidence contained in the [73] stratified rocks. I leave you to consider how far, by any ingenuity of interpretation, by any stretching of the meaning of language, it can be brought into harmony with the Miltonic hypothesis.

There remains the third hypothesis, that of which I have spoken as the hypothesis of evolution; and I purpose that, in lectures to come, we should discuss it as carefully as we have considered the other two hypotheses. I need not say that it is quite hopeless to look for testimonial evidence of evolution. The very nature of the case precludes the possibility of such evidence, for the human race can no more be expected to testify to its own origin, than a child can be tendered as a witness of its own birth. Our sole inquiry is, what foundation circumstantial evidence lends to the hypothesis, or whether it lends none, or whether it controverts the hypothesis. I shall deal with the matter entirely as a question of history I shall not indulge in the discussion of any speculative probabilities. I shall not attempt to show that Nature is unintelligible unless we adopt some such hypothesis. For anything I know about the matter, it may be the way of Nature to be unintelligible; she is often puzzling, and I have no reason to suppose that she is

bound to fit herself to our notions.

I shall place before you three kinds of evidence entirely based upon what is known of the forms of animal life which are contained in the series [74] of stratified rocks. I shall endeavour to show you that there is one kind of evidence which is neutral, which neither helps evolution nor is inconsistent with it. I shall then bring forward a second kind of evidence which indicates a strong probability in favour of evolution, but does not prove it; and, lastly, I shall adduce a third kind of evidence which, being as complete as any evidence which we can hope to obtain upon such a subject, and being wholly and strikingly in favour of evolution, may fairly be called demonstrative evidence of its occurrence.

II

THE HYPOTHESIS OF EVOLUTION. THE NEUTRAL AND THE FAVOURABLE EVIDENCE.

[75] In the preceding lecture I pointed out that there are three hypotheses which may be entertained, and which have been entertained, respecting the past history of life upon the globe. According to the first of these hypotheses, living beings, such as now exist, have existed from all eternity upon this earth. We tested that hypothesis by the circumstantial evidence, as I called it, which is furnished by the fossil remains contained in the earth's crust, and we found that it was obviously untenable. I then proceeded to consider the second hypothesis, which I termed the Miltonic hypothesis, not because it is of any particular consequence whether John Milton seriously entertained it or not, but because it is stated in a clear and unmistakable manner in his great poem. I pointed out to you that the evidence at our command as completely and fully negatives that hypothesis as it did the [76] preceding one. And I confess that I had too much respect for your intelligence to think it necessary to add that the negation was equally clear and equally valid, whatever the source from which that hypothesis might be derived, or whatever the authority by which it might be supported. I further stated that, according to the third hypothesis, or that of evolution, the existing state of things is the last term of a long series of states, which, when traced back, would be found to show no interruption and no breach in the continuity of natural causation. I propose, in the present and the following lecture, to test this hypothesis rigorously by the evidence at command, and to inquire how far that evidence can be said to be indifferent to it, how far it can be said to be favourable to it, and, finally, how far it can be said to be demonstrative.

From almost the origin of the discussions about the existing condition of the animal and vegetable worlds and the causes which have determined that condition, an argument has been put forward as an objection to evolution, which we shall have to consider very seriously. It is an argument which was first clearly stated by Cuvier in his criticism of the doctrines propounded by his great contemporary, Lamarck. The French expedition to Egypt had called the attention of learned men to the wonderful store of antiquities in that country, and there had been brought back to [77] France numerous mummified corpses of the animals which the ancient Egyptians revered and preserved, and which, at a reasonable computation, must have lived not less than three or four thousand years before the time at which they were thus brought to light. Cuvier endeavoured to test the hypothesis that animals have undergone gradual and progressive modifications of structure, by comparing the skeletons and such other parts of

the mummies as were in a fitting state of preservation, with the corresponding parts of the representatives of the same species now living in Egypt. He arrived at the conviction that no appreciable change had taken place in these animals in the course of this considerable lapse of time, and the justice of his conclusion is not disputed.

It is obvious that, if it can be proved that animals have endured, without undergoing any demonstrable change of structure, for so long a period as four thousand years, no form of the hypothesis of evolution which assumes that animals undergo a constant and necessary progressive change can be tenable; unless, indeed, it be further assumed that four thousand years is too short a time for the production of a change sufficiently great to be detected.

But it is no less plain that if the process of evolution of animals is not independent of surrounding conditions; if it may be indefinitely [78] hastened or retarded by variations in these conditions; or if evolution is simply a process of accommodation to varying conditions; the argument against the hypothesis of evolution based on the unchanged character of the Egyptian fauna is worthless. For the monuments which are coeval with the mummies testify as strongly to the absence of change in the physical geography and the general conditions of the land of Egypt, for the time in question, as the mummies do to the unvarying characters of its living population.

The progress of research since Cuvier's time has supplied far more striking examples of the long duration of specific forms of life than those which are furnished by the mummified Ibises and Crocodiles of Egypt. A remarkable case is to be found in your own country, in the neighbourhood of the falls of Niagara. In the immediate vicinity of the whirlpool, and again upon Goat Island, in the superficial deposits which cover the surface of the rocky subsoil in those regions, there are found remains of animals in perfect preservation, and among them, shells belonging to exactly the same species as those which at present inhabit the still waters of Lake Erie. It is evident, from the structure of the country, that these animal remains were deposited in the beds in which they occur at a time when the lake extended over the region in which they are found. This involves the conclusion that they lived and [79] died before the falls had cut their way back through the gorge of Niagara; and, indeed, it has been determined that, when these animals lived, the falls of Niagara must have been at least six miles further down the river than they are at present. Many computations have been made of the rate at which the falls are thus cutting their way back. Those computations have varied greatly, but I believe I am speaking within the bounds of prudence, if I assume that the falls of Niagara have not retreated at a greater pace than about a foot a year. Six miles, speaking roughly, are 30,000 feet; 30,000 feet, at a foot a year, gives 30,000 years; and thus we are fairly justified in concluding that no less a period than this has passed since the shell-fish, whose remains are left in the beds to which I have referred, were living creatures.

But there is still stronger evidence of the long duration of certain types. I have already stated that, as we work our way through the great series of the Tertiary formations, we find many species of animals identical with those which live at [80] the present day, diminishing in numbers, it is true, but still existing, in a certain proportion, in the oldest of the Tertiary rocks. Furthermore, when we examine the rocks of the Cretaceous epoch, we find the remains of some animals which the closest scrutiny cannot show to be, in any important respect, different from those which live at the present time. That is the case

with one of the cretaceous lamp-shells (*Terebratula*), which has continued to exist unchanged, or with insignificant variations, down to the present day. Such is the case with the *Globigerinæ*, the skeletons of which, aggregated together, form a large proportion of our English chalk. Those *Globigerinæ* can be traced down to the *Globigerinæ* which live at the surface of the present great oceans, and the remains of which, falling to the bottom of the sea, give rise to a chalky mud. Hence it must be admitted that certain existing species of animals show no distinct sign of modification, or transformation, in the course of a lapse of time as great as that which carries us back to the Cretaceous period; and which, whatever its absolute measure, is certainly vastly greater than thirty thousand years.

There are groups of species so closely allied together, that it needs the eye of a naturalist to distinguish them one from another. If we disregard the small differences which separate these forms, and consider all the species of such groups as modifications of one type, we shall find that, even among the higher animals, some types have had a marvellous duration. In the chalk, for example, there is found a fish belonging to the highest and the most differentiated group of osseous fishes, which goes by the name of *Beryx.* The remains of that fish are among the most [81] beautiful and well-preserved of the fossils found in our English chalk. It can be studied anatomically, so far as the hard parts are concerned, almost as well as if it were a recent fish. But the genus *Beryx* is represented, at the present day, by very closely allied species which are living in the Pacific and Atlantic Oceans. We may go still farther back. I have already referred to the fact that the Carboniferous formations, in Europe and in America, contain the remains of scorpions in an admirable state of preservation, and that those scorpions are hardly distinguishable from such as now live. I do not mean to say that they are not different, but close scrutiny is needed in order to distinguish them from modern scorpions.

More than this. At the very bottom of the Silurian series, in beds which are by some authorities referred to the Cambrian formation, where the signs of life begin to fail us–even there, among the few and scanty animal remains which are discoverable, we find species of molluscous animals which are so closely allied to existing forms that, at one time, they were grouped under the same generic name. I refer to the well-known *Lingula* of the *Lingula* flags, lately, in consequence of some slight differences, placed in the new genus *Lingulella.* Practically, it belongs to the same great generic group as the *Lingula,* which is to be found at the present day upon your own shores and those of many other parts of the world.

[82] The same truth is exemplified if we turn to certain great periods of the earth's history–as, for example, the Mesozoic epoch. There are groups of reptiles, such as the *Ichthyosauria* and the *Plesiosauria,* which appear shortly after the commencement of this epoch, and they occur in vast numbers. They disappear with the chalk and, throughout the whole of the great series of Mesozoic rocks, they present no such modifications as can safely be considered evidence of progressive modification.

Facts of this kind are undoubtedly fatal to any form of the doctrine of evolution which postulates the supposition that there is an intrinsic necessity, on the part of animal forms which have once come into existence, to undergo continual modification; and they are as distinctly opposed to any view which involves the belief, that such modification may occur, must take place, at the same rate, in all the different types of animal or vegetable life. The facts, as I have placed them before you, obviously directly contradict any form of the hypothesis of evolution which stands in need of these two postulates.

But, one great service that has been rendered by Mr. Darwin to the doctrine of evolution in general is this: he has shown that there are two chief factors in the process of evolution: one of them is the tendency to vary, the existence of which in all living forms may be proved by [83] observation; the other is the influence of surrounding conditions upon what I may call the parent form and the variations which are thus evolved from it. The cause of the production of variations is a matter not at all properly understood at present. Whether variation depends upon some intricate machinery–if I may use the phrase–of the living organism itself, or whether it arises through the influence of conditions upon that form, is not certain, and the question may, for the present, be left open. But the important point is that, granting the existence of the tendency to the production of variations; then, whether the variations which are produced shall survive and supplant the parent, or whether the parent form shall survive and supplant the variations, is a matter which depends entirely on those conditions which give rise to the struggle for existence. If the surrounding conditions are such that the parent form is more competent to deal with them, and flourish in them than the derived forms, then, in the struggle for existence, the parent form will maintain itself and the derived forms will be exterminated. But if, on the contrary, the conditions are such as to be more favourable to a derived than to the parent form, the parent form will be extirpated and the derived form will take its place. In the first case, there will be no progression, no change of structure, through any imaginable series of ages; in the second place [84] there will be modification of change and form.

Thus the existence of these persistent types, as I have termed them, is no real obstacle in the way of the theory of evolution. Take the case of the scorpions to which I have just referred. No doubt, since the Carboniferous epoch, conditions have always obtained, such as existed when the scorpions of that epoch flourished; conditions in which scorpions find themselves better off, more competent to deal with the difficulties in their way, than any variation from the scorpion type which they may have produced; and, for that reason, the scorpion type has persisted, and has not been supplanted by any other form. And there is no reason, in the nature of things, why, as long as this world exists, if there be conditions more favourable to scorpions than to any variation which may arise from them, these forms of life should not persist.

Therefore, the stock objection to the hypothesis of evolution, based on the long duration of certain animal and vegetable types, is no objection at all. The facts of this character–and they are numerous–belong to that class of evidence which I have called indifferent. That is to say, they may afford no direct support to the doctrine of evolution, but they are capable of being interpreted in perfect consistency with it.

There is another order of facts belonging to the class of negative or indifferent evidence. The [85] great group of Lizards, which abound in the present world, extends through the whole series of formations as far back as the Permian, or latest Palæozoic, epoch. These Permian lizards differ astonishingly little from the lizards which exist at the present day. Comparing the amount of the differences between them and modern lizards, with the prodigious lapse of time between the Permian epoch and the present day, it may be said that the amount of change is insignificant. But, when we carry our researches farther back in

time, we find no trace of lizards, nor of any true reptile whatever, in the whole mass of formations beneath the Permian.

Now, it is perfectly clear that if our palæontological collections are to be taken, even approximately, as an adequate representation of all the forms of animals and plants that have ever lived; and if the record furnished by the known series of beds of stratified rock covers the whole series of events which constitute the history of life on the globe, such a fact as this directly contravenes the hypothesis of evolution; because this hypothesis postulates that the existence of every form must have been preceded by that of some form little different from it. Here, however, we have to take into consideration that important truth so well insisted upon by Lyell and by Darwin–the imperfection of the geological record. It can be demonstrated that the geological record must [86] be incomplete, that it can only preserve remains found in certain favourable localities and under particular conditions; that it must be destroyed by processes of denudation, and obliterated by processes of metamorphosis. Beds of rock of any thickness crammed full of organic remains, may yet, either by the percolation of water through them, or by the influence of subterranean heat, lose all trace of these remains, and present the appearance of beds of rock formed under conditions in which living forms were absent. Such metamorphic rocks occur in formations of all ages; and, in various cases, there are very good grounds for the belief that they have contained organic remains, and that those remains have been absolutely obliterated.

I insist upon the defects of the geological record the more because those who have not attended to these matters are apt to say, "It is all very well, but, when you get into a difficulty with your theory of evolution, you appeal to the incompleteness and the imperfection of the geological record;" and I want to make it perfectly clear to you that this imperfection is a great fact, which must be taken into account in all our speculations, or we shall constantly be going wrong.

You see the singular series of footmarks, drawn of its natural size in the large diagram hanging up here (Fig. 2), which I owe to the kindness [87] of my friend Professor Marsh, with whom I had the opportunity recently of visiting the precise locality in Massachusetts in which these tracks occur. I am, therefore, able to give you my own testimony, if needed, that the diagram accurately represents what we saw. The valley of the Connecticut is classical ground for the geologist. It contains great beds of sandstone, covering many square miles, which have evidently formed a part of an ancient sea-shore, or, it may be, lake-shore. For a certain period of time after their deposition, these beds have remained sufficiently soft to receive the impressions of the feet of whatever animals walked over them, and to preserve them afterwards, in exactly the same way as such impressions are at this hour preserved on the shores of the Bay of Fundy and elsewhere. The diagram represents the track of some gigantic animal, which walked on its hind legs. You see the series of marks made alternately by the right and by the left foot; so that, from one impression to the other of the three-toed foot on the same side, is one stride, and that stride, as we mea[88]sured it, is six feet nine inches. I leave you, therefore, to form an impression of the magnitude of the creature which, as it walked along the ancient shore, made these impressions.

[87] Fig. 2.–Tracks of Brontozoum.

Of such impressions there are untold thousands upon these sandstones. Fifty or sixty different kinds have been discovered, and they cover vast areas. But, up to this present time, not a bone, not a fragment, of any one of the animals which left these great footmarks has been found; in fact, the only animal remains which have been met with in all these deposits, from the time of their discovery to the present day–though they have been carefully hunted over–is a fragmentary skeleton of one of the smaller forms. What has become of the bones of all these animals? You see we are not dealing with little creatures, but with animals that make a step of six feet nine inches; and their remains must have been left somewhere. The probability is, that they have been dissolved away, and completely lost.

I have had occasion to work out the nature of fossil remains, of which there was nothing left except casts of the bones, the solid material of the skeleton having been dissolved out by percolating water. It was a chance, in this case, that the sandstone happened to be of such a constitution as to set, and to allow the bones to be afterward dissolved out, leaving cavities of the exact shape of the bones. Had that constitution been other [89] than what it was, the bones would have been dissolved, the layers of sandstone would have fallen together into one mass, and not the slightest indication that the animal had existed would have been discoverable.

I know of no more striking evidence than these facts afford, of the caution which should be used in drawing the conclusion, from the absence of organic remains in a deposit, that animals or plants did not exist at the time it was formed. I believe that, with a right understanding of the doctrine of evolution on the one hand, and a just estimation of the importance of the imperfection of the geological record on the other, all difficulty is removed from the kind of evidence to which I have adverted; and that we are justified in believing that all such cases are examples of what I have designated negative or indifferent evidence–that is to say, they in no way directly advance the hypothesis of evolution, but they are not to be regarded as obstacles in the way of our belief in that doctrine.

I now pass on to the consideration of those cases which, for reasons which I will point out to you by and by, are not to be regarded as demonstrative of the truth of evolution, but which are such as must exist if evolution be true, and which therefore are, upon the whole, evidence in favour of the doctrine. If the doctrine of evolution be true, it follows, that, however diverse the different [90] groups of animals and of plants may be, they must all, at one time or other, have been connected by gradational forms; so that, from the highest animals, whatever they may be, down to the lowest speck of protoplasmic matter in which life can be manifested, a series of gradations, leading from one end of the series to the other, either exists or has existed. Undoubtedly that is a necessary postulate of the doctrine of evolution. But when we look upon living Nature as it is, we find a totally different state of things. We find that animals and plants fall into groups, the different members of which are pretty closely allied together, but which are separated by definite, larger or smaller, breaks, from other groups. In other words, no intermediate

forms which bridge over these gaps or intervals are, at present, to be met with.

To illustrate what I mean: Let me call your attention to those vertebrate animals which are most familiar to you, such as mammals, birds, and reptiles. At the present day, these groups of animals are perfectly well-defined from one another. We know of no animal now living which, in any sense, is intermediate between the mammal and the bird, or between the bird and the reptile; but, on the contrary, there are many very distinct anatomical peculiarities, well-defined marks, by which the mammal is separated from the bird, and the bird from the reptile. The [91] distinctions are obvious and striking if you compare the definitions of these great groups as they now exist.

The same may be said of many of the subordinate groups, or orders, into which these great classes are divided. At the present time, for example, there are numerous forms of non-ruminant pachyderms, or what we may call broadly, the pig tribe, and many varieties of ruminants. These latter have their definite characteristics, and the former have their distinguishing peculiarities. But there is nothing that fills up the gap between the ruminants and the pig tribe. The two are distinct. Such also is the case in respect of the minor groups of the class of reptiles. The existing fauna shows us crocodiles, lizards, snakes, and tortoises; but no connecting link between the crocodile and lizard, nor between the lizard and snake, nor between the snake and the crocodile, nor between any two of these groups. They are separated by absolute breaks. If, then, it could be shown that this state of things had always existed, the fact would be fatal to the doctrine of evolution. If the intermediate gradations, which the doctrine of evolution requires to have existed between these groups, are not to be found anywhere in the records of the past history of the globe, their absence is a strong and weighty negative argument against evolution; while, on the other hand, if such intermediate forms are to [92] be found, that is so much to the good of evolution; although, for reasons which I will lay before you by and by, we must be cautious in our estimate of the evidential cogency of facts of this kind.

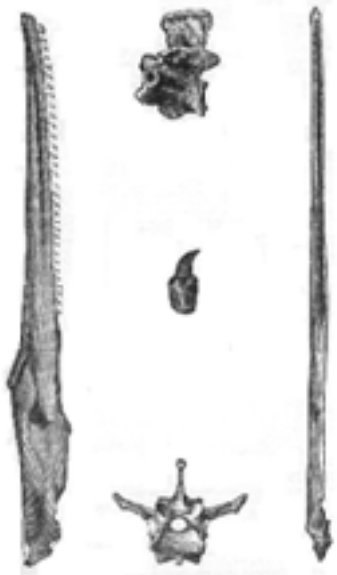
It is a very remarkable circumstance that, from the commencement of the serious study of fossil remains, in fact, from the time when Cuvier began his brilliant researches upon those found in the quarries of Montmartre, palæontology has shown what she was going to do in this matter, and what kind of evidence it lay in her power to produce.

I said just now that, in the existing Fauna, the group of pig-like animals and the group of ruminants are entirely distinct; but one of the first of Cuvier's discoveries was an animal which he called the *Anoplotherium*, and which proved to be, in a great many important respects, intermediate in character between the pigs, on the one hand, and the ruminants on the other. Thus, research into the history of the past did, to a certain extent, tend to fill up the breach between the group of ruminants and the group of pigs. Another remarkable animal restored by the great French palæontologist, the *Palæotheriurn*, similarly tended to connect together animals to all appearance so different as the rhinoceros, the horse, and the tapir. Subsequent research has brought to light multitudes of facts of the same order; and [93] at the present day, the investigations of such anatomists as Rütimeyer and Gaudry have tended to fill up, more and more, the gaps in our existing series of mammals, and to connect groups formerly thought to be distinct.

But I think it may have an especial interest if, instead of dealing with these examples, which would require a great deal of tedious osteological detail, I take the case of birds and reptiles; groups which, at the present day, are so clearly distinguished from one another that there are perhaps no classes of animals which, in popular apprehension, are more completely separated. Existing birds, as you are aware, are covered with feathers; their anterior extremities, specially and peculiarly modified, are converted into wings by the aid of which most of them are able to fly; they walk upright upon two legs; and these limbs, when they are considered anatomically, present a great number of exceedingly remarkable peculiarities, to which I may have occasion to advert incidentally as I go on, and which are not met with, even approximately, in any existing forms of reptiles. On the other hand, existing reptiles have no feathers. They may have naked skins, or be covered with horny scales, or bony plates, or with both. They possess no wings; they neither fly by means of their fore-limbs, nor habitually walk upright upon their hind-limbs; and the bones of their legs present no such modifications as we find in birds. It is impossible to [94] imagine any two groups more definitely and distinctly separated, notwithstanding certain characters which they possess in common.

As we trace the history of birds back in time, we find their remains, sometimes in great abundance, throughout the whole extent of the tertiary rocks; but, so far as our present knowledge goes, the birds of the tertiary rocks retain the same essential characters as the birds of the present day. In other words, the tertiary birds come within the definition of the class constituted by existing birds, and are as much separated from reptiles as existing birds are. Not very long ago no remains of birds had been found below the tertiary rocks, and I am not sure but that some persons were prepared to demonstrate that they could not have existed at an earlier period. But, in the course of the last few years, such remains have been discovered in England; though, unfortunately, in so imperfect and fragmentary a condition, that it is impossible to say whether they differed from existing birds in any essential character or not. In your country the development of the cretaceous series of rocks is enormous; the conditions under which the later cretaceous strata have been deposited are highly favourable to the preservation of organic remains; and the researches, full of labour and risk, which have been carried on by Professor Marsh in these cretaceous rocks of Western America, have rewarded him with the discovery of forms of birds of which we had hitherto no concep[95]tion. By his kindness, I am enabled to place before you a restoration of one of these extraordinary birds, every part of which can be thoroughly justified by the more or less complete skeletons, in a very perfect state of preservation, which he has discovered. This *Hesperornis* (Fig. 3), which measured between five and six feet in length, is astonishingly like our existing divers or grebes in a great many respects; so like them indeed that, had the skeleton of *Hesperornis* been found in a museum without its skull, it probably would have been placed in the same group of birds as the divers and grebes of the present day.[1] But *Hesperornis* differs from all existing birds, and so far resembles reptiles, in one important particular–it is provided with teeth. The long jaws are armed with teeth which have curved crowns and thick roots (Fig. 4), and are not set in distinct sockets, but are lodged in a groove. In possessing true teeth, the *Hesperornis* differs from every existing bird, and from every bird yet discovered in the tertiary formations, the tooth-like serrations of the jaws in the *Odontopteryx* of the London clay being mere processes of the bony substance of the jaws, and not teeth in the proper sense of the word. In view of the characteristics of this bird we are [96] therefore obliged to modify the definitions of the classes of birds and reptiles. Before the discovery of Hesperornis, the definition of the

class Aves based upon our knowledge of existing birds might [98] have been extended to all birds; it might have been said that the absence of teeth was characteristic of the class of birds; but the discovery of an animal which, in every part of its skeleton, closely agrees with existing birds, and yet possesses teeth, shows that there were ancient birds which, in respect of possessing teeth, approached reptiles more nearly than any existing bird does, and, to that extent, diminishes the *hiatus* between the two classes.



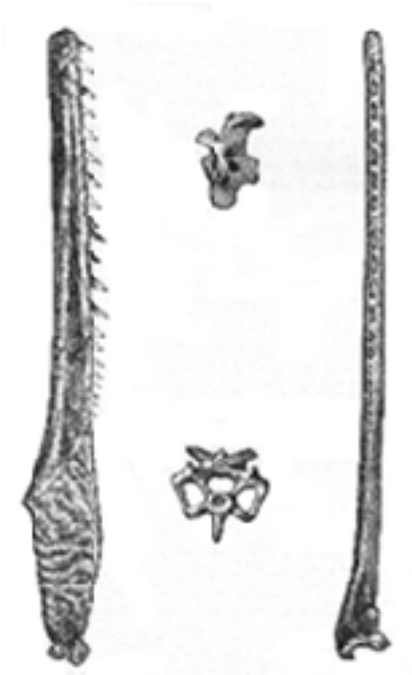
[96] Fig. 3–Hesperornis regalis (Marsh)

[97] Fig. 4–Hesperornis regalis (Marsh)

(Side and upper views of half the lower jaw; side and end views of a vertebra and a separate tooth.)

The same formation has yielded another bird, *Ichthyornis* (Fig. 5), which also possesses teeth; but the teeth are situated in distinct sockets, while those of *Hesperornis* are not so lodged. The latter also has such very small, almost rudimentary wings, that it must have been chiefly a swimmer and a diver like a Penguin; while *Ichthyornis* has strong wings and no doubt possessed corresponding powers of flight.

Ichthyornis also differed in the fact that its vertebræ have not the peculiar characters of the vertebræ of existing and of all known tertiary birds, but were concave at each end. This discovery leads us to make a further modification in the definition of the group of birds, and to part with another of the characters by which almost all existing birds are distinguished from reptiles.



[99] Fig. 5–Ichthyornis Dispar (Marsh).
(Side and upper views of half the lower jaw; and side and end views of a vertebra.)

Apart from the few fragmentary remains from the English greensand, to which I have referred, the Mesozoic rocks, older than those in which [100] *Hesperornis* and *Ichthyornis* have been discovered, have afforded no certain evidence of birds, with the remarkable exception of the Solenhofen slates. These so-called slates are composed of a fine grained calcareous mud which has hardened into lithographic stone, and in which organic remains are almost as well preserved as they would be if they had been imbedded in so much plaster of Paris. They have yielded the *Archæopteryx*, the existence of which was first made known by the finding of a fossil feather, or rather of the impression of one. It is wonderful enough that such a perishable thing as a feather, and nothing more, should be discovered; yet, for a long time, nothing was known of this bird except its feather. But by and by a solitary skeleton was discovered which is now in the British Museum. The skull of this solitary specimen is unfortunately wanting, and it is therefore uncertain whether the *Archæopteryx* possessed teeth or not.[2] But the remainder of the skeleton is so well preserved as to leave no doubt respecting the main features of the animal, which are very singular. The feet are not only altogether bird-like, but have the special characters of the feet of perching birds, while the body had a clothing of true feathers. Nevertheless, in some other respects, *Archæopteryx* is unlike a bird and like a reptile. There is a long tail composed of [101] many vertebræ. The structure of the wing differs in some very remarkable respects from that which it presents in a true bird. In the latter, the end of the wing answers to the thumb and two fingers of my hand; but the metacarpal bones, or those which answer to the bones of the fingers which lie in the palm of the hand, are fused together into one mass; and the whole apparatus, except the last joints of the

thumb, is bound up in a sheath of integument, while the edge of the hand carries the principal quill-feathers. In the *Archæopteryx,* the upper-arm bone is like that of a bird; and the two bones of the forearm are more or less like those of a bird, but the fingers are not bound together–they are free. What their number may have been is uncertain; but several, if not all, of them were terminated by strong curved claws, not like such as are sometimes found in birds, but such as reptiles possess; so that, in the *Archæopteryx,* we have an animal which, to a certain extent, occupies a midway place between a bird and a reptile. It is a bird so far as its foot and sundry other parts of its skeleton are concerned; it is essentially and thoroughly a bird by its feathers; but it is much more properly a reptile in the fact that the region which represents the hand has separate bones, with claws resembling those which terminate the forelimb of a reptile. Moreover, it has a long reptile-like tail with a fringe of feathers on each side; while, in all true birds [102] hitherto known, the tail is relatively short, and the vertebræ which constitute its skeleton are generally peculiarly modified.

Like the *Anoplotherium* and the *Palæotherium,* therefore, *Archæopteryx* tends to fill up the interval between groups which, in the existing world, are widely separated, and to destroy the value of the definitions of zoological groups based upon our knowledge of existing forms. And such cases as these constitute evidence in favour of evolution, in so far as they prove that, in former periods of the world's history, there were animals which overstepped the bounds of existing groups, and tended to merge them into larger assemblages. They show that animal organisation is more flexible than our knowledge of recent forms might have led us to believe; and that many structural permutations and combinations, of which the present world gives us no indication, may nevertheless have existed.

But it by no means follows, because the *Palæotherium* has much in common with the horse, on the one hand, and with the rhinoceros on the other, that it is the intermediate form through which rhinoceroses have passed to become horses, or *vice versa;* on the contrary, any such supposition would certainly be erroneous. Nor do I think it likely that the transition from the reptile to the bird has been effected by such a form as *Archæopteryx.* And it is convenient to distinguish these intermediate forms between two groups, which do [103] not represent the actual passage from the one group to the other, as *intercalary* types, from those *linear* types which, more or less approximately, indicate the nature of the steps by which the transition from one group to the other was effected.

I conceive that such linear forms, constituting a series of natural gradations between the reptile and the bird, and enabling us to understand the manner in which the reptilian has been metamorphosed into the bird type, are really to be found among a group of ancient and extinct terrestrial reptiles known as the *Ornithoscelida.* The remains of these animals occur throughout the series of mesozoic formations, from the Trias to the Chalk, and there are indications of their existence even in the later Palæozoic strata.

Most of these reptiles, at present known, are of great size, some having attained a length of forty feet or perhaps more. The majority resembled lizards and crocodiles in their general form, and many of them were, like crocodiles, protected by an armour of heavy bony plates. But, in others, the hind limbs elongate and the fore limbs shorten, until their relative proportions approach those which are observed in the short-winged, flightless, ostrich tribe among birds.

The skull is relatively light, and in some cases the jaws, though bearing teeth, are beak-like at their extremities and appear to have been enveloped in a horny sheath. In the part of the vertebral column which lies between the haunch bones and [104] is called the sacrum, a number of vertebræ may unite together into one whole, and in this respect, as in some details of its structure, the sacrum of these reptiles approaches that of birds.

But it is in the structure of the pelvis and of the hind limb that some of these ancient reptiles present the most remarkable approximation to birds, and clearly indicate the way by which the most specialised and characteristic features of the bird may have been evolved from the corresponding parts of the reptile.

In Fig. 6, the pelvis and hind limbs of a crocodile, a three-toed bird, and an ornithoscelidan are represented side by side; and, for facility of comparison, in corresponding positions; but it must be recollected that, while the position of the bird's limb is natural, that of the crocodile is not so. In the bird, the thigh bone lies close to the body, and the metatarsal bones of the foot (ii., iii., iv., Fig. 6) are, ordinarily, raised into a more or less vertical position; in the crocodile, the thigh bone stands out at an angle from the body, and the metatarsal bones (i., ii., iii., iv., Fig. 6) lie flat on the ground. Hence, in the crocodile, the body usually lies squat between the legs, while, in the bird, it is raised upon the hind legs, as upon pillars.

In the crocodile, the pelvis is obviously composed of three bones on each side: the ilium (*Il.*), the pubis (*Pb.*), and the ischium (*Is.*). In the adult bird there appears to be but one bone on [105] each side. The examination of the pelvis of a chick, however, shows that each half is made up of three bones, which answer to those which remain distinct throughout life in the crocodile. There is, therefore, a fundamental identity of plan in the construction of the pelvis of both bird and reptile; though the difference in form, relative size, and direction of the corresponding bones in the two cases are very great.

But the most striking contrast between the two lies in the bones of the leg and of that part of the foot termed the tarsus, which follows upon the leg. In the crocodile, the fibula (*F*) is relatively large and its lower end is complete. The tibia (*T*) has no marked crest at its upper end, and its lower end is narrow and not pulley-shaped. There are two rows of separate tarsal bones (*As., Ca.,* &c.) and four distinct metatarsal bones, with a rudiment of a fifth.

In the bird, the fibula is small and its lower end diminishes to a point. The tibia has a strong crest at its upper end and its lower extremity passes into a broad pulley. There seem at first to be no tarsal bones; and only one bone, divided at the end into three heads for the three toes which are attached to it, appears in the place of the metatarsus.

In the young bird, however, the pulley-shaped apparent end of the tibia is a distinct bone, which represents the bones marked *As., Ca.,* in the crocodile; while the apparently single metatarsal bone [106] consists of three bones, which early unite with one another and with an additional bone, which represents the lower row of bones in the tarsus of the crocodile.

In other words, it can be shown by the study of development that the bird's pelvis and hind limb are simply extreme modifications of the same fundamental plan as that upon which these parts are modelled in reptiles.

On comparing the pelvis and hind limb of the ornithoscelidan with that of the crocodile, on the one side, and that of the bird, on the other (Fig. 6), it is obvious that it represents a middle term between the two. The pelvic bones approach the form of those of the birds, and the direction of the pubis and ischium is nearly that which is characteristic of birds; the thigh bone, from the direction of its head, must have lain close to the body; the tibia has a great crest; and, immovably fitted on to its lower end, there is a pulley-shaped bone, like that of the bird, but remaining distinct. The lower end of the fibula is much more slender, proportionally, than in the crocodile. The metatarsal bones have such a form that they fit together immovably, though they do not enter into bony union; the third toe is, as in the bird, longest and strongest. In fact, the ornithoscelidan limb is comparable to that of an unhatched chick.

[107]

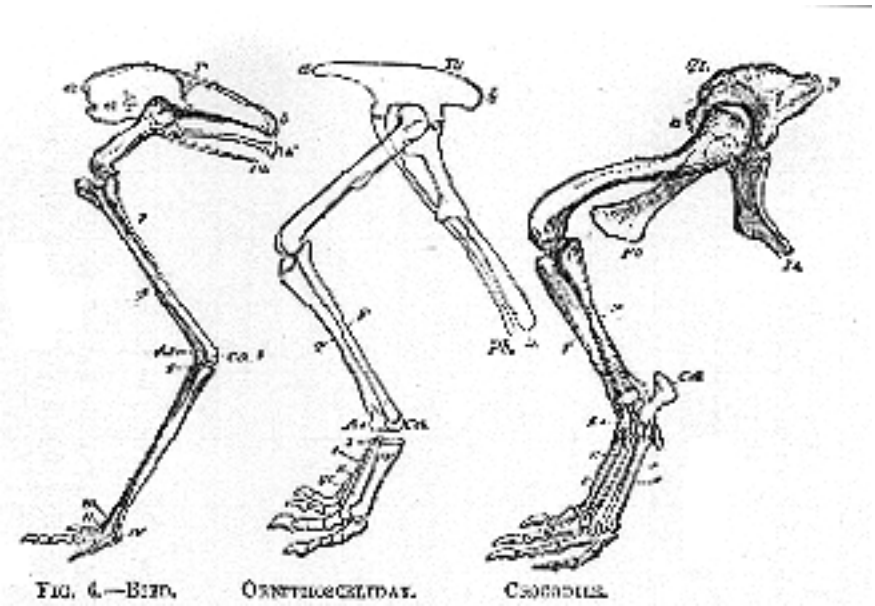


Fig. 6.–Bird. Ornithoscelidan. Crocodile.

The letters have the same signification in all the figures. *Il.*, Ilium; *a.* anterior end; *b.* posterior end; *Ia.* ischium; *Pb.*, pubis; *T*, tibia; *F*, fibula; *As.*, astragalus; *Ca.*, calcaneum; I, distal portion of the tarsus; i., ii., iii., iv., metatarsal bones.

Taking all these facts together, it is obvious that the view, which was entertained by Mantell and the probability of which was demonstrated by [107] your own distinguished anatomist, Leidy, while much additional evidence in the same direction has been furnished by Professor Cope, that some [108] of these animals may have walked upon their hind legs as birds do, acquires great weight. In fact, there can be no reasonable doubt that one of the smaller forms of the *Ornithoscelida, Compsognathus,* the almost entire skeleton of which has been discovered in the Solenhofen slates, was a bipedal animal. The parts of this skeleton are somewhat twisted out of their natural relations, but the accompanying figure gives a just view of the general form of *Compsognathus* and of the proportions of its limbs; which, in some respects,

are more completely bird-like than those of other *Ornithoscelida.*

[108]

Fig. 7.–Restoration of Compsognathus Longipes

[109] We have had to stretch the definition of the class of birds so as to include birds with teeth and birds with paw-like fore limbs and long tails. There is no evidence that *Compsognathus* possessed feathers; but, if it did, it would be hard indeed to say whether it should be called a reptilian bird or an avian reptile.

As *Compsognathus* walked upon its hind legs, it must have made tracks like those of birds. And as the structure of the limbs of several of the gigantic *Ornithoscelida,* such as *Iguanodon,* leads to the conclusion that they also may have constantly, or occasionally, assumed the same attitude, a peculiar interest attaches to the fact that, in the Wealden strata of England, there are to be found gigantic footsteps, arranged in order like those of the *Brontozoum,* and which there can be no reasonable doubt were made by some of the *Ornithoscelida,* the remains of which are found in the same rocks. And, knowing that reptiles that walked upon their hind legs and shared many of the anatomical characters of birds did once exist, it becomes a very important question whether the tracks in the Trias of Massachusetts, to which I referred some time ago, and which formerly used to be unhesitatingly ascribed to birds, may not all have been made by ornithoscelidan reptiles; and whether, if we could obtain the skeletons of the animals which made these tracks, we should not find in them the actual steps of the evo [110]lutional process by which reptiles gave rise to birds.

The evidential value of the facts I have brought forward in this Lecture must be neither over nor under estimated. It is not historical proof of the occurrence of the evolution of birds from reptiles, for we have no safe ground for assuming that true birds had not made their appearance at the commencement of the

Mesozoic epoch. It is, in fact, quite possible that all these more or less avi-form reptiles of the Mesozoic epochs are not terms in the series of progression from birds to reptiles at all, but simply the more or less modified descendants of Palæozoic forms through which that transition was actually effected.

We are not in a position to say that the known *Ornithoscelida* are intermediate in the order of their appearance on the earth between reptiles and birds. All that can be said is that, if independent evidence of the actual occurrence of evolution is producible, then these intercalary forms remove every difficulty in the way of understanding what the actual steps of the process, in the case of birds, may have been.

That intercalary forms should have existed in ancient times is a necessary consequence of the truth of the hypothesis of evolution; and, hence, the evidence I have laid before you in proof of the existence of such forms, is, so far as it goes, in favour of that hypothesis.

[111] There is another series of extinct reptiles which may be said to be intercalary between reptiles and birds, in so far as they combine some of the characters of both these groups; and which, as they possessed the power of flight, may seem, at first sight, to be nearer representatives of the forms by which the transition from the reptile to the bird was effected, than the *Ornithoscelida.*

These are the *Pterosauria,* or Pterodactyles, the remains of which are met with throughout the series of Mesozoic rocks, from the lias to the chalk, and some of which attained a great size, their wings having a span of eighteen or twenty feet. These animals, in the form and proportions of the head and neck relatively to the body, and in the fact that the ends of the jaws were often, if not always, more or less extensively ensheathed in horny beaks, remind us of birds. Moreover, their bones contained air cavities, rendering them specifically lighter, as is the case in most birds. The breast bone was large and keeled, as in most birds and in bats, and the shoulder girdle is strikingly similar to that of ordinary birds. But, it seems to me, that the special resemblance of pterodactyles to birds ends here, unless I may add the entire absence of teeth which characterises the great pterodactyles *(Pteranodon)* discovered by Professor Marsh. All other known pterodactyles have teeth lodged in sockets. In the vertebral column and [112] the hind limbs there are no special resemblances to birds, and when we turn to the wings they are found to be constructed on a totally different principle from those of birds.

[112]

Fig. 8.–Pterodactylus Spectabilis (Von Meyer).

[113] There are four fingers. These four fingers are large, and three of them, those which answer to the thumb and two following fingers in my hand–are terminated by claws, while the fourth is enormously prolonged and converted into a great jointed style. You see at once, from what I have stated about a bird's wing, that there could be nothing less like a bird's wing than this is. It was concluded by general reasoning that this finger had the office of supporting a web which extended between it and the body. An existing specimen proves that such was really the case, and that the pterodactyles were devoid of feathers, but that the fingers supported a vast web like that of a bat's wing; in fact, there can be no doubt that this ancient reptile flew after the fashion of a bat.

Thus, though the pterodactyle is a reptile which has become modified in such a manner as to enable it to fly, and therefore, as might be expected, presents some points of resemblance to other animals which fly; it has, so to speak, gone off the line which leads directly from reptiles to birds, and has become disqualified for the changes which lead to the characteristic organisation of the latter class. Therefore, viewed in relation to the classes of reptiles and birds, the pterodactyles appear to me to be, in a limited sense, intercalary forms; but they are not even approximately linear, in the sense of exemplifying those modifications of structure through which the passage from the reptile to the bird took place.

III

THE DEMONSTRATIVE EVIDENCE OF EVOLUTION

[114] The occurrence of historical facts is said to be demonstrated, when the evidence that they happened is of such a character as to render the assumption that they did not happen in the highest

degree improbable; and the question I now have to deal with is, whether evidence in favour of the evolution of animals of this degree of cogency is, or is not, obtainable from the record of the succession of living forms which is presented to us by fossil remains.

Those who have attended to the progress of palæontology are aware that evidence of the character which I have defined has been produced in considerable and continually-increasing quantity during the last few years. Indeed, the amount and the satisfactory nature of that evidence are somewhat surprising, when we consider the conditions under which alone we can hope to obtain it.

[115] It is obviously useless to seek for such evidence except in localities in which the physical conditions have been such as to permit of the deposit of an unbroken, or but rarely interrupted, series of strata through a long period of time; in which the group of animals to be investigated has existed in such abundance as to furnish the requisite supply of remains; and in which, finally, the materials composing the strata are such as to ensure the preservation of these remains in a tolerably perfect and undisturbed state.

It so happens that the case which, at present, most nearly fulfils all these conditions is that of the series of extinct animals which culminates in the horses; by which term I mean to denote not merely the domestic animals with which we are all so well acquainted, but their allies, the ass, zebra, quagga, and the like. In short, I use "horses" as the equivalent of the technical name *Equidæ,* which is applied to the whole group of existing equine animals.

The horse is in many ways a remarkable animal; not least so in the fact that it presents us with an example of one of the most perfect pieces of machinery in the living world. In truth, among the works of human ingenuity it cannot be said that there is any locomotive so perfectly adapted to its purposes, doing so much work with so small a quantity of fuel, as this machine of nature's manufacture–the horse. And, as a neces[116]sary consequence of any sort of perfection, of mechanical perfection as of others, you find that the horse is a beautiful creature, one of the most beautiful of all land-animals. Look at the perfect balance of its form, and the rhythm and force of its action. The locomotive machinery is, as you are aware, resident in its slender fore and hind limbs; they are flexible and elastic levers, capable of being moved by very powerful muscles; and, in order to supply the engines which work these levers with the force which they expend, the horse is provided with a very perfect apparatus for grinding its food and extracting therefrom the requisite fuel.

Without attempting to take you very far into the region of osteological detail, I must nevertheless trouble you with some statements respecting the anatomical structure of the horse; and, more especially, will it be needful to obtain a general conception of the structure of its fore and hind limbs, and of its teeth. But I shall only touch upon those points which are absolutely essential to our inquiry.

Let us turn in the first place to the fore-limb. In most quadrupeds, as in ourselves, the fore-arm contains distinct bones called the radius and the ulna. The corresponding region in the horse seems at first to possess but one bone. Careful observation, however, enables us to distinguish in this bone a part which

clearly answers to the upper [117] end of the ulna. This is closely united with the chief mass of the bone which represents the radius, and runs out into a slender shaft which may be traced for some distance downwards upon the back of the radius, and then in most cases thins out and vanishes. It takes still more trouble to make sure of what is nevertheless the fact, that a small part of the lower end of the bone of the horse's fore arm, which is only distinct in a very young foal, is really the lower extremity of the ulna.

What is commonly called the knee of a horse is its wrist. The "cannon bone" answers to the middle bone of the five metacarpal bones, which support the palm of the hand in ourselves. The "pastern," "coronary," and "coffin" bones of veterinarians answer to the joints of our middle fingers, while the hoof is simply a greatly enlarged and thickened nail. But if what lies below the horse's "knee" thus corresponds to the middle finger in ourselves, what has become of the four other fingers or digits? We find in the places of the second and fourth digits only two slender splint-like bones, about two-thirds as long as the cannon bone, which gradually taper to their lower ends and bear no finger joints, or, as they are termed, phalanges. Sometimes, small bony or gristly nodules are to be found at the bases of these two metacarpal splints, and it is probable that these represent rudiments of the first and fifth toes. Thus, the part of the horse's skeleton, which [118] corresponds with that of the human hand, contains one overgrown middle digit, and at least two imperfect lateral digits; and these answer, respectively, to the third, the second, and the fourth fingers in man.

Corresponding modifications are found in the hind limb. In ourselves, and in most quadrupeds, the leg contains two distinct bones, a large bone, the tibia, and a smaller and more slender bone, the fibula. But, in the horse, the fibula seems, at first, to be reduced to its upper end; a short slender bone united with the tibia, and ending in a point below, occupying its place. Examination of the lower end of a young foal's shin bone, however, shows a distinct portion of osseous matter, which is the lower end of the fibula; so that the apparently single, lower end of the shin bone is really made up of the coalesced ends of the tibia and fibula, just as the, apparently single, lower end of the fore-arm bone is composed of the coalesced radius and ulna.

The heel of the horse is the part commonly known as the hock. The hinder cannon bone answers to the middle metatarsal bone of the human foot, the pastern, coronary, and coffin bones, to the middle toe bones; the hind hoof to the nail; as in the fore-foot. And, as in the fore-foot, there are merely two splints to represent the second and the fourth toes. Sometimes a rudiment of a fifth toe appears to be traceable.

[119] The teeth of a horse are not less peculiar than its limbs. The living engine, like all others, must be well stoked if it is to do its work; and the horse, if it is to make good its wear and tear, and to exert the enormous amount of force required for its propulsion, must be well and rapidly fed. To this end, good cutting instruments and powerful and lasting crushers are needful. Accordingly, the twelve cutting teeth of a horse are close-set and concentrated in the fore-part of its mouth, like so many adzes or chisels. The grinders or molars are large, and have an extremely complicated structure, being composed of a number of different substances of unequal hardness. The consequence of this is that they wear away at different rates; and, hence, the surface of each grinder is always as uneven as that of a good millstone.

I have said that the structure of the grinding teeth is very complicated, the harder and the softer parts being, as it were, interlaced with one another. The result of this is that, as the tooth wears, the crown presents a peculiar pattern, the nature of which is not very easily deciphered at first; but which it is important we should understand clearly. Each grinding tooth of the upper jaw has an *outer wall* so shaped that, on the worn crown, it exhibits the form of two crescents, one in front and one behind, with their concave sides turned outwards. From the inner side of the [120] front crescent, a crescentic *front ridge* passes inwards and backwards, and its inner face enlarges into a strong longitudinal fold or *pillar*. From the front part of the hinder crescent, a *back ridge* takes a like direction, and also has its *pillar*.

The deep interspaces or *valleys* between these ridges and the outer wall are filled by bony substance, which is called *cement*, and coats the whole tooth.

The pattern of the worn face of each grinding tooth of the lower jaw is quite different. It appears to be formed of two crescent-shaped ridges, the convexities of which are turned outwards. The free extremity of each crescent has a *pillar*, and there is a large double *pillar* where the two crescents meet. The whole structure is, as it were, imbedded in cement, which fills up the valleys, as in the upper grinders.

If the grinding faces of an upper and of a lower molar of the same side are applied together, it will be seen that the opposed ridges are nowhere parallel, but that they frequently cross; and that thus, in the act of mastication, a hard surface in. the one is constantly applied to a soft surface in the other, and *vice versa*. They thus constitute a grinding apparatus of great efficiency, and one which is repaired as fast as it wears, owing to the long-continued growth of the teeth.

Some other peculiarities of the dentition of the horse must be noticed, as they bear upon what I [121] shall have to say by and by. Thus the crowns of the cutting teeth have a peculiar deep pit, which gives rise to the well-known "mark" of the horse. There is a large space between the outer incisors and the front grinder. In this space the adult male horse presents, near the incisors on each side, above and below, a canine or "tush," which is commonly absent in mares. In a young horse, moreover, there is not unfrequently to be seen in front of the first grinder, a very small tooth, which soon falls out. If this small tooth be counted as one, it will be found that there are seven teeth behind the canine on each side; namely, the small tooth in question, and the six great grinders, among which, by an unusual peculiarity, the foremost tooth is rather larger than those which follow it.

I have now enumerated those characteristic structures of the horse which are of most importance for the purpose we have in view.

To any one who is acquainted with the morphology of vertebrated animals, they show that the horse deviates widely from the general structure of mammals; and that the horse type is, in many respects, an extreme modification of the general mammalian plan. The least modified mammals, in fact, have the radius and ulna, the tibia and fibula, distinct and separate. They have five distinct and complete digits on each foot, and no one of these digits is very much [122] larger than the rest. Moreover, in the least modified mammals, the total number of the teeth is very generally forty-four, while in horses, the usual

number is forty, and in the absence of the canines, it may be reduced to thirty-six; the incisor teeth are devoid of the fold seen in those of the horse: the grinders regularly diminish in size from the middle of the series to its front end; while their crowns are short, early attain their full length, and exhibit simple ridges or tubercles, in place of the complex foldings of the horse's grinders.

Hence the general principles of the hypothesis of evolution lead to the conclusion that the horse must have been derived from some quadruped which possessed five complete digits on each foot; which had the bones of the fore-arm and of the leg complete and separate; and which possessed forty-four teeth, among which the crowns of the incisors and grinders had a simple structure; while the latter gradually increased in size from before backwards, at any rate in the anterior part of the series, and had short crowns.

And if the horse has been thus evolved, and the remains of the different stages of its evolution have been preserved, they ought to present us with a series of forms in which the number of the digits becomes reduced; the bones of the fore-arm and leg gradually take on the equine condition; and the form and arrangement of the teeth [123] successively approximate to those which obtain in existing horses.

Let us turn to the facts, and see how far they fulfil these requirements of the doctrine of evolution.

In Europe abundant remains of horses are found in the Quaternary and later Tertiary strata as far as the Pliocene formation. But these horses, which are so common in the cave-deposits and in the gravels of Europe, are in all essential respects like existing horses. And that is true of all the horses of the latter part of the Pliocene epoch. But, in deposits which belong to the earlier Pliocene and later Miocene epochs, and which occur in Britain, in France, in Germany, in Greece, in India, we find animals which are extremely like horses–which, in fact, are so similar to horses, that you may follow descriptions given in works upon the anatomy of the horse upon the skeletons of these animals–but which differ in some important particulars. For example, the structure of their fore and hind limbs is somewhat different. The bones which, in the horse, are represented by two splints, imperfect below, are as long as the middle metacarpal and metatarsal bones; and, attached to the extremity of each, is a digit with three joints of the same general character as those of the middle digit, only very much smaller. These small digits are so disposed that they could have had but very [124] little functional importance, and they must have been rather of the nature of the dew-claws, such as are to be found in many ruminant animals. The *Hipparion*, as the extinct European three-toed horse is called, in fact, presents a foot similar to that of the American *Protohippus* (Fig. 9), except that, in the *Hipparion*, the smaller digits are situated farther back, and are of smaller proportional size, than in the *Protohippus*.

The ulna is slightly more distinct than in the horse; and the whole length of it, as a very slender shaft, intimately united with the radius, is completely traceable. The fibula appears to be in the same condition as in the horse. The teeth of the *Hipparion* are essentially similar to those of the horse, but the pattern of the grinders is in some respects a little more complex, and there is a depression on the face of the skull in front of the orbit, which is not seen in existing horses.

In the earlier Miocene, and perhaps the later Eocene deposits of some parts of Europe, another extinct animal has been discovered, which Cuvier, who first described some fragments of it, considered to be a *Palæotheriun.* But as further discoveries threw new light upon its structure, it was recognised as a distinct genus, under the name of *Anchitherium.*

In its general characters, the skeleton of *Anchitherium* is very similar to that of the horse. In [125] fact, Lartet and De Blainville called it *Palæotherium equinum* or *hippoides;* and De Christol, in 1847, said that it differed from *Hipparion* in little more than the characters of its teeth, and gave it the name of *Hipparitherium.* Each foot possesses three complete toes; while the lateral toes are much larger in proportion to the middle toe than in *Hipparion,* and doubtless rested on the ground in ordinary locomotion.

The ulna is complete and quite distinct from the radius, though firmly united with the latter. The fibula seems also to have been complete. Its lower end, though intimately united with that of the tibia, is clearly marked off from the latter bone.

There are forty-four teeth. The incisors have no strong pit. The canines seem to have been well developed in both sexes. The first of the seven grinders, which, as I have said, is frequently absent, and, when it does exist, is small in the horse, is a good-sized and permanent tooth, while the grinder which follows it is but little larger than the hinder ones. The crowns of the grinders are short, and though the fundamental pattern of the horse-tooth is discernible, the front and back ridges are less curved, the accessory pillars are wanting, and the valleys, much shallower, are not filled up with cement.

Seven years ago, when I happened to be looking critically into the bearing of palæntological facts [126] upon the doctrine of evolution, it appeared to me that the *Anchitherium,* the *Hipparion,* and the modern horses, constitute a series in which the modifications of structure coincide with the order of chronological occurrence, in the manner in which they must coincide, if the modern horses really are the result of the gradual metamorphosis, in the course of the Tertiary epoch, of a less specialised ancestral form. And I found by correspondence with the late eminent French anatomist and palæontologist, M. Lartet, that he had arrived at the same conclusion from the same data.

That the *Anchitherium* type had become metamorphosed into the *Hipparion* type, and the latter into the *Equine* type, in the course of that period of time which is represented by the latter half of the Tertiary deposits, seemed to me to be the only explanation of the facts for which there was even a shadow of probability.[3]

And, hence, I have ever since held that these facts afford evidence of the occurrence of evolution, which, in the sense already defined, may be termed demonstrative.

[127] All who have occupied themselves with the structure of *Anchitherium,* from Cuvier onwards, have acknowledged its many points of likeness to a well-known genus of extinct Eocene mammals, *Palæotherium.* Indeed, as we have seen, Cuvier regarded his remains of *Anchitherium* as those of a

species of *Palæotherium.* Hence, in attempting to trace the pedigree of the horse beyond the Miocene epoch and the Anchitheroid form, I naturally sought among the various species of Palæotheroid animals for its nearest ally, and I was led to conclude that the *Palæotherium minus (Plagiolophus)* represented the next step more nearly than any form then known.

I think that this opinion was fully justifiable; but the progress of investigation has thrown an unexpected light on the question, and has brought us much nearer than could have been anticipated to a knowledge of the true series of the progenitors of the horse.

You are all aware that, when your country was first discovered by Europeans, there were no traces of the existence of the horse in any part of the American Continent. The accounts of the conquest of Mexico dwell upon the astonishment of the natives of that country when they first became acquainted with that astounding phenomenon–a man seated upon a horse. Nevertheless, the investigations of American geologists have proved that the remains of horses occur in [128] the most superficial deposits of both North and South America, just as they do in Europe. Therefore, for some reason or other–no feasible suggestion on that subject, so far as I know, has been made–the horse must have died out on this continent at some period preceding the discovery of America. Of late years there has been discovered in your Western Territories that marvellous accumulation of deposits, admirably adapted for the preservation of organic remains, to which I referred the other evening, and which furnishes us with a consecutive series of records of the fauna of the older half of the Tertiary epoch, for which we have no parallel in Europe. They have yielded fossils in an excellent state of conservation and in unexampled number and variety. The researches of Leidy and others have shown that forms allied to the *Hipparion* and the *Anchitherium* are to be found among these remains. But it is only recently that the admirably conceived and most thoroughly and patiently worked-out investigations of Professor Marsh have given us a just idea of the vast fossil wealth, and of the scientific importance, of these deposits. I have had the advantage of glancing over the collections in Yale Museum; and I can truly say that, so far as my knowledge extends, there is no collection from any one region and series of strata comparable, for extent, or for the care with which the remains have been got to[129]gether, or for their scientific importance, to the series of fossils which he has deposited there. This vast collection has yielded evidence bearing upon the question of the pedigree of the horse of the most striking character. It tends to show that we must look to America, rather than to Europe, for the original seat of the equine series; and that the archaic forms and successive modifications of the horse's ancestry are far better preserved here than in Europe.

Professor Marsh's kindness has enabled me to put before you a diagram, every figure in which is an actual representation of some specimen which is to be seen at Yale at this present time (Fig. 9).

[130]

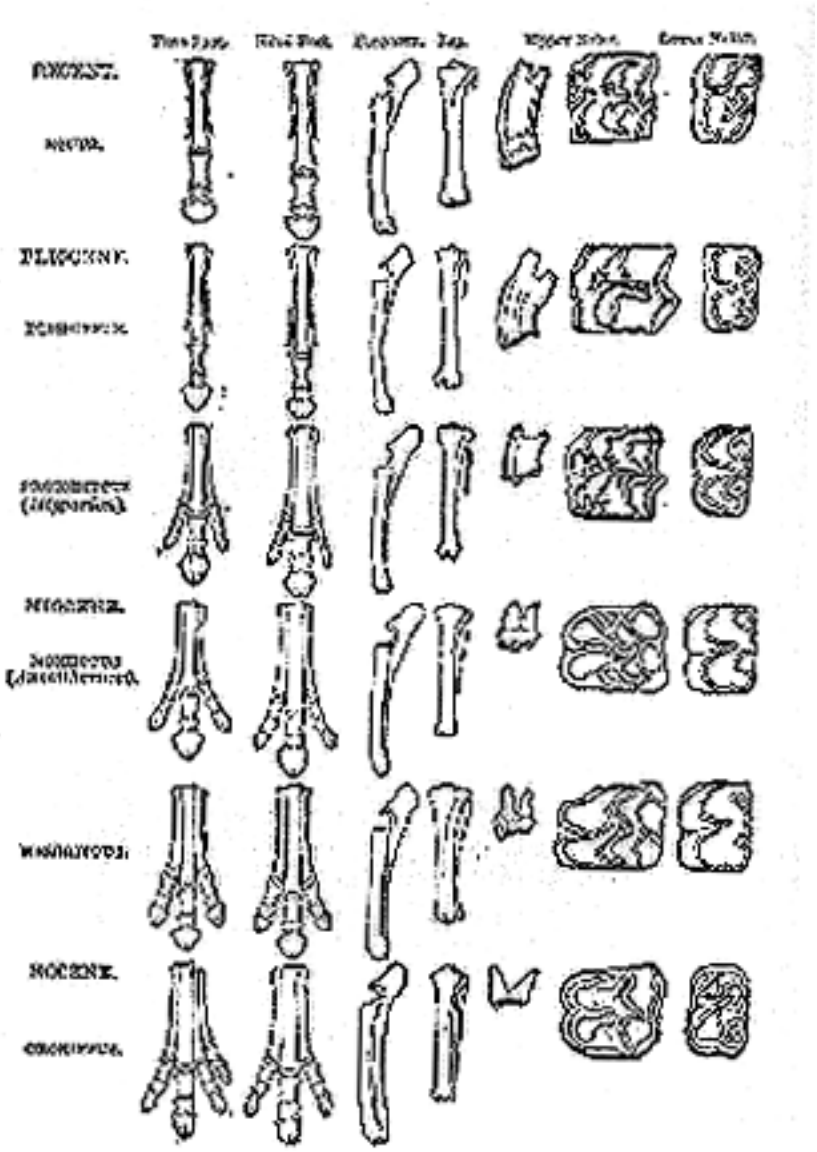


Fig. 9.

The succession of forms which he has brought together carries us from the top to the bottom of the Tertiaries. Firstly, there is the true horse. Next we have the American Pliocene form of the horse (*Pliohippus*); in the conformation of its limbs it presents some very slight deviations from the ordinary horse, and the crowns of the grinding teeth are shorter. Then comes the *Protohippus,* which represents the European *Hipparion*, having one large digit and two small ones on each foot, and the general characters of the fore-arm and leg to which I have referred. But it is more valuable than the European *Hipparion* for the reason that it is devoid of some of the peculiarities of that form–peculiarities which tend to show that the [131] European *Hipparion* is rather a member of a collateral branch, than a form in the direct line of succession. Next, in the backward order in time, is the *Miohippus*, which corresponds pretty nearly with the *Anchitherium* of Europe. It presents three complete toes–one large median and two smaller lateral ones; and there is a rudiment of that digit, which answers to the little finger of the human hand.

The European record of the pedigree of the horse stops here; in the American Tertiaries, on the contrary, the series of ancestral equine forms is continued into the Eocene formations. An older Miocene form,

termed *Mesohippus*, has three toes in front, with a large splint-like rudiment representing the little finger; and three toes behind. The radius and ulna, the tibia and the fibula, are distinct, and the short crowned molar teeth are anchitherioid in pattern.

But the most important discovery of all is the *Orohippus*, which comes from the Eocene formation, and is the oldest member of the equine series, as yet known. Here we find four complete toes on the front limb, three toes on the hind limb, a well-developed ulna, a well-developed fibula, and short-crowned grinders of simple pattern.

Thus, thanks to these important researches, it has become evident that, so far as our present knowledge extends, the history of the horse-type is exactly and precisely that which could have been [132] predicted from a knowledge of the principles of evolution. And the knowledge we now possess justifies us completely in the anticipation, that when the still lower Eocene deposits, and those which belong to the Cretaceous epoch, have yielded up their remains of ancestral equine animals, we shall find, first, a form with four complete toes and a rudiment of the innermost or first digit in front, with, probably, a rudiment of the fifth digit in the hind foot;[4] while, in still older forms, the series of the digits will be more and more complete, until we come to the five-toed animals, in which, if the doctrine of evolution is well founded, the whole series must have taken its origin.

That is what I mean by demonstrative evidence of evolution. An inductive hypothesis is said to be demonstrated when the facts are shown to be in entire accordance with it. If that is not scientific proof, there are no merely inductive conclusions which can be said to be proved. And the doctrine of evolution, at the present time, rests upon exactly as secure a foundation as the Copernican theory of the motions of the heavenly bodies did at the time of its promulgation. Its logical basis is precisely of the [133] same character–the coincidence of the observed facts with theoretical requirements.

The only way of escape, if it be a way of escape, from the conclusions which I have just indicated, is the supposition that all these different equine forms have been created separately at separate epochs of time; and, I repeat, that of such an hypothesis as this there neither is, nor can be, any scientific evidence; and, assuredly, so far as I know, there is none which is supported, or pretends to be supported, by evidence or authority of any other kind. I can but think that the time will come when such suggestions as these, such obvious attempts to escape the force of demonstration, will be put upon the same footing as the supposition made by some writers, who are I believe not completely extinct at present, that fossils are mere simulacra, are no indications of the former existence of the animals to which they seem to belong; but that they are either sports of nature, or special creations, intended–as I heard suggested the other day–to test our faith.

In fact, the whole evidence is in favour of evolution, and there is none against it. And I say this, although perfectly well aware of the seeming difficulties which have been built up upon what appears to the uninformed to be a solid foundation. I meet constantly with the argument that the doctrine of evolution cannot be well founded, because it requires the lapse of a very [134] vast period of time; while the duration of life upon the earth thus implied is inconsistent with the conclusions arrived at by the

astronomer and the physicist. I may venture to say that I am familiar with those conclusions, inasmuch as some years ago, when President of the Geological Society of London, I took the liberty of criticising them, and of showing in what respects, as it appeared to me, they lacked complete and thorough demonstration. But, putting that point aside, suppose that, as the astronomers, or some of them, and some physical philosophers, tell us, it is impossible that life could have endured upon the earth for as long a period as is required by the doctrine of evolution–supposing that to be proved–I desire to be informed, what is the foundation for the statement that evolution does require so great a time? The biologist knows nothing whatever of the amount of time which may be required for the process of evolution. It is a matter of fact that the equine forms which I have described to you occur, in the order stated, in the Tertiary formations. But I have not the slightest means of guessing whether it took a million of years, or ten millions, or a hundred millions, or a thousand millions of years, to give rise to that series of changes. A biologist has no means of arriving at any conclusion as to the amount of time which may be needed for a certain quantity of organic change. He takes [135] his time from the geologist. The geologist, considering the rate at which deposits are formed and the rate at which denudation goes on upon the surface of the earth, arrives at more or less justifiable conclusions as to the time which is required for the deposit of a certain thickness of rocks; and if he tells me that the Tertiary formations required 500,000,000 years for their deposit, I suppose he has good ground for what he says, and I take that as a measure of the duration of the evolution of the horse from the *Orohippus* up to its present condition. And, if he is right, undoubtedly evolution is a very slow process, and requires a great deal of time. But suppose, now, that an astronomer or a physicist–for instance, my friend Sir William Thomson–tells me that my geological authority is quite wrong; and that he has weighty evidence to show that life could not possibly have existed upon the surface of the earth 500,000,000 years ago, because the earth would have then been too hot to allow of life, my reply is: "That is not my affair; settle that with the geologist, and when you have come to an agreement among yourselves I will adopt your conclusion." We take our time from the geologists and physicists; and it is monstrous that, having taken our time from the physical philosopher's clock, the physical philosopher should turn round upon us, and say we are too fast or too slow. What we [136] desire to know is, is it a fact that evolution took place? As to the amount of time which evolution may have occupied, we are in the hands of the physicist and the astronomer, whose business it is to deal with those questions.

I have now, ladies and gentlemen, arrived at the conclusion of the task which I set before myself when I undertook to deliver these lectures. My purpose has been, not to enable those among you who have paid no attention to these subjects before, to leave this room in a condition to decide upon the validity or the invalidity of the hypothesis of evolution; but I have desired to put before you the principles upon which all hypotheses respecting the history of Nature must be judged; and furthermore, to make apparent the nature of the evidence and the amount of cogency which is to be expected and may be obtained from it. To this end, I have not hesitated to regard you as genuine students and persons desirous of knowing the truth. I have not shrunk from taking you through long discussions, that I fear may have sometimes tried your patience; and I have inflicted upon you details which were indispensable, but which may well have been wearisome. But I shall rejoice–I shall consider that I have done you the greatest service which it was in my power to do–if I have thus convinced you that the great question which [137] we have been discussing is not one to be dealt with by rhetorical flourishes, or by loose and superficial talk; but that it requires the keen attention of the trained intellect and the patience of the accurate observer.

When I commenced this series of lectures, I did not think it necessary to preface them with a prologue, such as might be expected from a stranger and a foreigner; for during my brief stay in your country, I have found it very hard to believe that a stranger could be possessed of so many friends, and almost harder that a foreigner could express himself in your language in such a way as to be, to all appearance, so readily intelligible. So far as I can judge, that most intelligent, and perhaps, I may add, most singularly active and enterprising body, your press reporters, do not seem to have been deterred by my accent from giving the fullest account of everything that I happen to have said.

But the vessel in which I take my departure to-morrow morning is even now ready to slip her moorings; I awake from my delusion that I am other than a stranger and a foreigner. I am ready to go back to my place and country; but, before doing so, let me, by way of epilogue, tender to you my most hearty thanks for the kind and cordial reception which you have accorded to me; and let me thank you still more [138] for that which is the greatest compliment which can be afforded to any person in my position–the continuous and undisturbed attention which you have bestowed upon the long argument which I have had the honour to lay before you.

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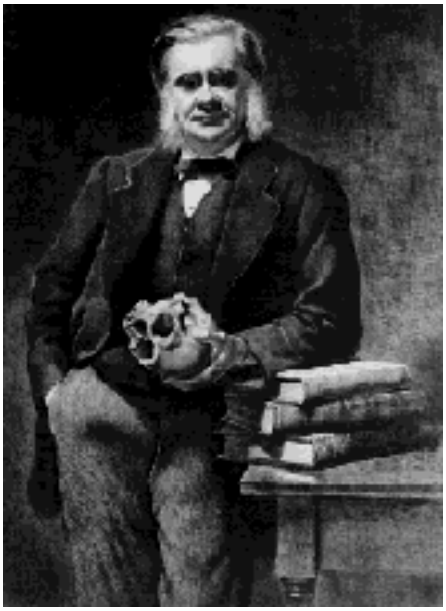
[1] The absence of any keel on the breast-bone and some other osteological peculiarities, observed by Professor Marsh, however, suggest that *Hesperornis* may be a modification of a less specialised group of birds than that to which these existing aquatic birds belong.

[2] A second specimen, discovered in 1877, and at present in the Berlin museum, shows an excellently preserved skull with teeth; and three digits, all terminated by claws, in the fore limb. 1893.

[3] I use the word "type" because it is highly probable that many forms of *Anchitherium*-like and *Hipparion*-like animals existed in the Miocene and Pliocene epochs, just as many species of the horse tribe exist now, and it is highly improbable that the particular species of *Anchitherium* or *Hipparion,* which happen to have been discovered, should be precisely those which have formed part of the direct line of the horse's pedigree.

[4] Since this lecture was delivered, Professor Marsh has discovered a new genus of equine mammals (*Eohippus*) from the lowest Eocene deposits of the West, which corresponds very nearly to this description.–*American Journal of Science,* November, 1876.

THE HUXLEY FILE



Preface and Table of Contents to Volume IV, *Science and Hebrew Tradition,* of Huxley's *Collected Essays.*

Next article: The Interpreters of Genesis and the Interpreters of Nature [1885], pages 139-163.

Previous article: The Rise and Progress of Palæontology [1881], pages 24-45.

C. Blinderman & D. Joyce
Clark University

The Interpreters of Genesis and the Interpreters of Nature (1885)

Collected Essays IV

[139] Our fabulist warns "those who in quarrels interpose" of the fate which is probably in store for them; and, in venturing to place myself between so powerful a controversialist as Mr. Gladstone and the eminent divine whom he assaults with such vigour in the last number of this Review,[1] I am fully aware that I run great danger of verifying Gay's prediction. Moreover, it is quite possible that my zeal in offering aid to a combatant so extremely well able to take care of himself as M. Réville may be thought to savour of indiscretion.

Two considerations, however, have led me to face the double risk. The one is that though, in my judgment, M. Réville is wholly in the right in that part of the controversy to which I propose to restrict my observations, nevertheless he, as a [140] foreigner, has very little chance of making the truth prevail with Englishmen against the authority and the dialectic skill of the greatest master of persuasive rhetoric among English-speaking men of our time. As the Queen's proctor intervenes, in certain cases, between two litigants in the interests of justice, so it may be permitted me to interpose as a sort of uncommissioned science proctor. My second excuse for my meddlesomeness is, that important questions of natural science–respecting which neither of the combatants professes to speak as an expert–are involved in the controversy; and I think it is desirable that the public should know what it is that natural science really has to say on these topics, to the best belief of one who has been a diligent student of natural science for the last forty years.

The original "Prolégomènes de l'Histoire des Religions" has not come in my way; but I have read the translation of M. Réville's work, published in England under the auspices of Professor Max Müller, with very great interest. It puts more fairly and clearly than any book previously known to me, the view which a man of strong religious feelings, but at the same time possessing the information and the reasoning power which enable him to estimate the strength of scientific methods of inquiry and the weight of scientific truth, may be expected to take of the relation between science and religion.

[141] In the chapter on "The Primitive Revelation" the scientific worth of the account of the Creation given in the book of Genesis is estimated in terms which are as unquestionably respectful as, in my judgment, they are just; and, at the end of the chapter on "Primitive Tradition," M. Réville appraises the value of pentateuchal anthropology in a way which I should have thought sure of enlisting the assent of all competent judges, even if it were extended to the whole of the cosmogony and biology of Genesis:–

"As, however, the original traditions of nations sprang up in an epoch less remote than our own from the primitive life, it is indispensable to consult them, to compare them, and to associate them with other sources of information which are availahle. From this point of view, the traditions recorded in Genesis possess, in addition to their own peculiar charm, a value of the highest order; but we cannot ultimately see in them more than a venerable fragment, well-deserving attention, of the great genesis of mankind."

Mr. Gladstone is of a different mind. He dissents from M. Réville's views respecting the proper estimation of the pentateuchal traditions, no less than he does from his interpretation of those Homeric myths which have been the object of his own special study. In the latter case, Mr. Gladstone tells M. Réville that he is wrong on his own authority, to which, in such a matter, all will pay due respect: in the former, he affirms himself to be "wholly destitute of that kind of knowledge which carries authority," and his rebuke is [142] administered in the name and by the authority of natural science.

An air of magisterial gravity hangs about the following passage:–

"But the question is not here of a lofty poem, or a skilfully constructed narrative: it is whether natural science, in the patient exercise of its high calling to examine facts, finds that the works of God cry out against what we have fondly believed to be His word and tell another tale; or whether, in this nineteenth century of Christian progress, it substantially echoes back the majestic sound, which, before it existed as a pursuit, went forth into all lands.

First, looking largely at the latter portion of the narrative, which describes the creation of living organisms, and waiving details, on some of which (as in v. 24) the Septuagint seems to vary from the Hebrew, there is a grand fourfold division, set forth in an orderly succession of times as follows: on the fifth day

1. The water-population;

2. The air-population; and, on the sixth day,

3. The land-population of animals;

4. The land-population consummated in man.

Now this same fourfold order is understood to have been so affirmed in our time by natural science, that it may be taken as a demonstrated conclusion and established fact" (p. 696).

"Understood?" By whom? I cannot bring myself to imagine that Mr. Gladstone has made so solemn and authoritative a statement on a matter of this importance without due inquiry–without being able to found himself upon recognised scientific authority. But I wish he had thought fit to name the source from whence he has derived his information, as, in that case, I could have dealt with [143] his authority, and I should have thereby escaped the appearance of making an attack on Mr. Gladstone himself, which is in every way distasteful to me.

For I can meet the statement in the last paragraph of the above citation with nothing but a direct negative. If I know anything at all about the results attained by the natural science of our time, it is "a demonstrated conclusion and established fact" that the "fourfold order" given by Mr. Gladstone is not that in which the evidence at our disposal tends to show that the water, air, and land-populations of the globe have made their appearance.

Perhaps I may be told that Mr. Gladstone does give his authority–that he cites Cuvier, Sir John Herschel, and Dr. Whewell in support of his case. If that has been Mr. Gladstone's intention in mentioning these eminent names, I may remark that, on this particular question, the only relevant authority is that of Cuvier. But great as Cuvier was, it is to be remembered that, as Mr. Gladstone incidentally remarks, he cannot now be called a recent authority. In fact, he has been dead more than half a century; and the palæontology of our day is related to that of his, very much as the geography of the sixteenth century is related to that of the fourteenth. Since 1832, when Cuvier died, not only a new world, but new worlds, of ancient life have been discovered; and those who [144] have most faithfully carried on the work of the chief founder of palæontology have done most to invalidate the essentially negative grounds of his speculative adherence to tradition.

If Mr. Gladstone's latest information on these matters is derived from the famous discourse prefixed to the "Ossemens Fossiles," I can understand the position he has taken up; if he has ever opened a respectable modern manual of palæontology, or geology, I cannot. For the facts which demolish his whole argument are of the commonest notoriety. But before proceeding to consider the evidence for this assertion we must be clear about the meaning of the phraseology employed.

I apprehend that when Mr. Gladstone uses the term "water-population" he means those animals which in Genesis i. 21 (Revised Version) are spoken of as "the great sea monsters and every living creature that moveth, which the waters brought forth abundantly, after their kind." And I presume that it will be agreed that whales and porpoises, sea fishes, and the innumerable hosts of marine invertebrated animals, are meant thereby. So "air-population" must be the equivalent of "fowl" in verse 20, and "every winged fowl after its kind," verse 21. I suppose I may take it for granted that by "fowl" we have here to understand birds–at any rate primarily. Secondarily, it may be that the bats and the extinct pterodactyles, which were flying reptiles, come under the same head. But [145] whether all insects are "creeping things" of the land-population, or whether flying insects are to be included under the denomination of "winged fowl," is a point for the decision of Hebrew exegetes. Lastly, I suppose I may assume that "land-population" signifies "the cattle" and "the beasts of the earth," and "every creeping thing that creepeth upon the earth," in verses 25 and 26; presumably it comprehends all kinds of terrestrial animals, vertebrate and invertebrate, except such as may be comprised under the head of the "air-population."

Now what I want to make clear is this: that if the terms "water-population," "air-population," and "land-population" are understood in the senses here defined, natural science has nothing to say in favour of the proposition that they succeeded one another in the order given by Mr. Gladstone; but that, on the contrary, all the evidence we possess goes to prove that they did not. Whence it will follow that, if Mr. Gladstone has interpreted Genesis rightly (on which point I am most anxious to be understood to offer no opinion), that interpretation is wholly irreconcilable with the conclusions at present accepted by the interpreters of nature–with everything that can be called "a demonstrated conclusion and established fact" of natural science. And be it observed that I am not here dealing with a question of speculation, but with a question of fact.

[146] Either the geological record is sufficiently complete to afford us a means of determining the order in which animals have made their appearance on the globe or it is not. If it is, the determination of that

order is little more than a mere matter of observation; if it is not, then natural science neither affirms nor refutes the "fourfold order," but is simply silent.

The series of the fossiliferous deposits, which contain the remains of the animals which have lived on the earth in past ages of its history, and which can alone afford the evidence required by natural science of the order of appearance of their different species, may be grouped in the manner shown in the left-hand column of the following table, the oldest being at the bottom:–

Formations	First known appearance of
Quaternary.	
Pliocene.	
Miocene.	
Eocene.	Vertebrate *air*-population (Bats).
Cretaceous.	
Jurassic.	Vertebrate *air*-population (Birds and Pterodactyles).
Triassic.	
Upper Palæozoic.	
Middle Palæozoic.	Vertebrate *land*-population (Amphibia, Reptilia [?]).
Lower Palæozoic.	
Silurian.	Vertebrate *water*-population (Fishes). Invertebrate *air* and *land*-population (Flying Insects and Scorpions).
Cambrian.	Invertebrate *water*-population (much earlier, if *Eozoon* is animal).

[147] In the right-hand column I have noted the group of strata in which, according to our present information, the *land, air,* and *water* populations respectively appear for the first time; and in consequence of the ambiguity about the meaning of "fowl," I have separately indicated the first appearance of bats, birds, flying reptiles, and flying insects. It will be observed that, if "fowl" means only "bird," or at most flying vertebrate, then the first certain evidence of the latter, in the Jurassic epoch, is posterior to the first appearance of truly terrestrial *Amphibia,* and possibly of true reptiles, in the Carboniferous epoch (Middle Palæozoic) by a prodigious interval of time.

The water-population of vertebrated animals first appears in the Upper Silurian.[2] Therefore, if we found ourselves on vertebrated animals and take "fowl" to mean birds only, or, at most, flying vertebrates, natural science says that the order of succession was water, land, and air-population, and not–as Mr. Gladstone, founding himself on Genesis, says–water, air, land-population. If a chronicler of Greece affirmed that the age of Alexander preceded that of Pericles and immediately succeeded that of the Trojan war, Mr. Gladstone would hardly say that this order is "understood to have been so affirmed by historical science that it may be taken as a demonstrated conclusion and established fact." Yet natural science "affirms" his "fourfold order" [148] to exactly the same extent–neither more nor less.

Suppose, however, that "fowl" is to be taken to include flying insects. In that case, the first appearance of an air-population must be shifted back for long ages, recent discovery having shown that they occur in rocks of Silurian age. Hence there might still have been hope for the fourfold order, were it not that the fates unkindly determined that scorpions–"creeping things that creep on the earth" *par excellence*–turned up in Silurian strata nearly at the same time. So that, if the word in the original Hebrew translated "fowl" should really after all mean "cockroach"–and I have great faith in the elasticity of that tongue in the hands of Biblical exegetes–the order primarily suggested by the existing evidence–

2. Land and air-population;
1. Water-population;

and Mr. Gladstone's order–

3. Land-population;
2. Air-population;
1. Water-population;

can by no means be made to coincide. As a matter of fact, then, the statement so confidently put forward turns out to be devoid of foundation and in direct contradiction of the evidence at present at our disposal.[3]

[149] If, stepping beyond that which may be learned from the facts of the successive appearance of the forms of animal life upon the surface of the globe, in so far as they are yet made known to us by natural science, we apply our reasoning faculties to the task of finding out what those observed facts mean, the present conclusions of the interpreters of nature appear to be no less directly in conflict with those of the latest interpreter of Genesis.

Mr. Gladstone appears to admit that there is some truth in the doctrine of evolution, and indeed places it under very high patronage.

"I contend that evolution in its highest form has not been a thing heretofore unknown to history, to philosophy, or to theology. I contend that it was before the mind of Saint Paul when he taught that in the fulness of time God sent forth His Son, and of Eusebius when he wrote the 'Preparation for the Gospel,' and of Augustine when he composed the 'City of God'" (p. 706).

[150] Has any one ever disputed the contention, thus solemnly enunciated, that the doctrine of evolution was not invented the day before yesterday? Has any one ever dreamed of claiming it as a modern innovation? Is there any one so ignorant of the history of philosophy as to be unaware that it is one of the forms in which speculation embodied itself long before the time either of the Bishop of Hippo or of the Apostle to the Gentiles? Is Mr. Gladstone, of all people in the world, disposed to ignore the founders of Greek philosophy, to say nothing of Indian sages to whom evolution was a familiar notion ages

before Paul of Tarsus was born? But it is ungrateful to cavil at even the most oblique admission of the possible value of one of those affirmations of natural science which really may be said to be "a demonstrated conclusion and established fact." I note it with pleasure, if only for the purpose of introducing the observation that, if there is any truth whatever in the doctrine of evolution as applied to animals, Mr. Gladstone's gloss on Genesis in the following passage is hardly happy:–

God created

(a) The water-population;

(b) The air-population.

And they receive His benediction (v. 20-23).

6. Pursuing this regular progression from the lower to the higher, from the simple to the complex, the text now gives us the work of the sixth "day," which supplies the land-population, air and water having been already supplied (pp. 695, 696).

[151] The gloss to which I refer is the assumption that the "air-population" forms a term in the order of progression from lower to higher, from simple to complex–the place of which lies between the water-population below and the land-population above–and I speak of it as a "gloss," because the pentateuchal writer is nowise responsible for it.

But it is not true that the air-population, as a whole, is "lower" or less "complex" than the land-population. On the contrary, every beginner in the study of animal morphology is aware that the organisation of a bat, of a bird, or of a pterodactyle presupposes that of a terrestrial quadruped; and that it is intelligible only as an extreme modification of the organisation of a terrestrial mammal or reptile. In the same way winged insects (if they are to be counted among the "air-population") presuppose insects which were wingless, and, therefore, as "creeping things," were part of the land-population. Thus theory is as much opposed as observation to the admission that natural science endorses the succession of animal life which Mr. Gladstone finds in Genesis. On the contrary, a good many representatives of natural science would be prepared to say, on theoretical grounds alone, that it is incredible that the "air-population" should have appeared before the "land-population"–and that, if this assertion is to be found in Genesis, it merely [152] demonstrates the scientific worthlessness of the story of which it forms a part.

Indeed, we may go further. It is not even admissible to say that the water-population, as a whole, appeared before the air and the land-populations. According to the Authorised Version, Genesis especially mentions, among the animals created on the fifth day, "great whales," in place of which the Revised Version reads "great sea monsters." Far be it from me to give an opinion which rendering is right, or whether either is right. All I desire to remark is, that if whales and porpoises, dugongs and manatees, are to be regarded as members of the water-population (and if they are not, what animals can claim the designation?), then that much of the water-population has, as certainly, originated later than the land-population as bats and birds have. For I am not aware that any competent judge would hesitate

to admit that the organisation of these animals shows the most obvious signs of their descent from terrestrial quadrupeds.

A similar criticism applies to Mr. Gladstone's assumption that, as the fourth act of that "orderly succession of times" enunciated in Genesis, "the land-population consummated in man."

If this means simply that man is the final term in the evolutional series of which he forms a part, I do not suppose that any objection will be raised to that statement on the part of students of [153] natural science. But if the pentateuchal author goes further than this, and intends to say that which is ascribed to him by Mr. Gladstone, I think natural science will have to enter a *caveat.* It is not by any means certain that man–I mean the species *Homo sapiens* of zoological terminology–has "consummated" the land-population in the sense of appearing at a later period of time than any other. Let me make my meaning clear by an example. From a morphological point of view, our beautiful and useful contemporary–I might almost call him colleague–the horse (*Equus caballus*), is the last term of the evolutional series to which he belongs, just as *Homo sapiens* is the last term of the series of which he is a member. If I want to know whether the species *Equus caballus* made its appearance on the surface of the globe before or after *Homo sapiens,* deduction from known laws does not help me. There is no reason, that I know of, why one should have appeared sooner or later than the other. If I turn to observation, I find abundant remains of *Equus caballus* in Quaternary strata, perhaps a little earlier. The existence of *Homo sapiens* in the Quaternary epoch is also certain. Evidence has been adduced in favour of man's existence in the Pliocene, or even in the Miocene epoch. It does not satisfy me; but I have no reason to doubt that the fact may be so, nevertheless. Indeed, I think it is quite possible that further [154] research will show that *Homo sapiens* existed, not only before *Equus caballus,* but before many other of the existing forms of animal life; so that, if all the species of animals have been separately created, man, in this case, would by no means be the "consummation" of the land-population.

I am raising no objection to the position of the fourth term in Mr. Gladstone's "order"–on the facts, as they stand, it is quite open to any one to hold, as a pious opinion, that the fabrication of man was the acme and final achievement of the process of peopling the globe. But it must not be said that natural science counts this opinion among her "demonstrated conclusions and established facts," for there would be just as much, or as little, reason for ranging the contrary opinion among them.

It may seem superfluous to add to the evidence that Mr. Gladstone has been utterly misled in supposing that his interpretation of Genesis receives any support from natural science. But it is as well to do one's work thoroughly while one is about it; and I think it may be advisable to point out that the facts, as they are at present known, not only refute Mr. Gladstone's interpretation of Genesis in detail, but are opposed to the central idea on which it appears to be based.

There must be some position from which the reconcilers of science and Genesis will not retreat, some central idea the maintenance of which is vital and its refutation fatal. Even if they now allow [155] that the words "the evening and the morning" have not the least reference to a natural day, but mean a period of any number of millions of years that may be necessary; even if they are driven to admit that the word

"creation," which so many millions of pious Jews and Christians have held, and still hold, to mean a sudden act of the Deity, signifies a process of gradual evolution of one species from another, extending through immeasurable time; even if they are willing to grant that the asserted coincidence of the order of Nature with the "fourfold order" ascribed to Genesis is an obvious error instead of an established truth; they are surely prepared to make a last stand upon the conception which underlies the whole, and which constitutes the essence of Mr. Gladstone's "fourfold division, set forth in an orderly succession of times." It is, that the animal species which compose the water-population, the air-population, and the land-population respectively, originated during three distinct and successive periods of time, and only during those periods of time.

This statement appears to me to be the interpretation of Genesis which Mr. Gladstone supports, reduced to its simplest expression. "Period of time" is substituted for "day"; "originated" is substituted for "created"; and "any order required" for that adopted by Mr. Gladstone. It is necessary to make this proviso, for if "day" may mean a few million years, and "creation" may [156] mean evolution, then it is obvious that the order (1) water-population, (2) air-population, (3) land-population, may also mean (1) water-population, (2) land-population, (3) air-population; and it would be unkind to bind down the reconcilers to this detail when one has parted with so many others to oblige them.

But even this sublimated essence of the pentateuchal doctrine (if it be such) remains as discordant with natural science as ever.

It is not true that the species composing any one of the three populations originated during any one of three successive periods of time, and not at any other of these.

Undoubtedly, it is in the highest degree probable that animal life appeared first under aquatic conditions; that terrestrial forms appeared later, and flying animals only after land animals; but it is, at the same time, testified by all the evidence we possess, that the great majority, if not the whole, of the primordial species of each division have long since died out and have been replaced by a vast succession of new forms. Hundreds of thousands of animal species, as distinct as those which now compose our water, land, and air-populations, have come into existence and died out again, throughout the æons of geological time which separate us from the lower Palæozoic epoch, when, as I have pointed out, our present evidence of the existence of such distinct populations commences. [157] If the species of animals have all been separately created, then it follows that hundreds of thousands of acts of creative energy have occurred, at intervals, throughout the whole time recorded by the fossiliferous rocks; and, during the greater part of that time, the "creation" of the members of the water, land, and air-populations must have gone on contemporaneously.

If we represent the water, land, and air-populations by *a*, *b*, and *c* respectively, and take vertical succession on the page to indicate order in time, then the following schemes will roughly shadow forth the contrast I have been endeavouring to explain:–

Genesis (as interpreted by Mr. Gladstone). Nature (as interpreted by natural science).

b b b	c^1 a^3 b^2
c c c	*c* a^2 b^1
a a a	*b* a^1 *b*
	a a a

So far as I can see, there is only one resource left for those modern representatives of Sisyphus, the reconcilers of Genesis with science; and it has the advantage of being founded on a perfectly legitimate appeal to our ignorance. It has been seen that, on any interpretation of the terms water-population and land-population, it must be admitted that invertebrate representatives of these populations existed during the lower Palæozoic epoch. No evolutionist can hesitate to admit that other land animals (and possibly vertebrates among [158] them) may have existed during that time, of the history of which we know so little; and, further, that scorpions are animals of such high organisation that it is highly probable their existence indicates that of a long antecedent land-population of a similar character.

Then, since the land-population is said not to have been created until the sixth day, it necessarily follows that the evidence of the order in which animals appeared must be sought in the record of those older Palæozoic times in which only traces of the water-population have as yet been discovered.

Therefore, if any one chooses to say that the creative work took place in the Cambrian or Laurentian epoch, in exactly that manner which Mr. Gladstone does, and natural science does not, affirm, natural science is not in a position to disprove the accuracy of the statement. Only one cannot have one's cake and eat it too, and such safety from the contradiction of science means the forfeiture of her support.

Whether the account of the work of the first, second, and third days in Genesis would be confirmed by the demonstration of the truth of the nebular hypothesis; whether it is corroborated by what is known of the nature and probable relative antiquity of the heavenly bodies; whether, if the Hebrew word translated "firmament" in the Authorised Version really means "expanse," the assertion that the waters are partly under [159] this "expanse" and partly above it would be any more confirmed by the ascertained facts of physical geography and meteorology than it was before; whether the creation of the whole vegetable world, and especially of "grass, herb yielding seed after its kind, and tree bearing fruit," before any kind of animal, is "affirmed" by the apparently plain teaching of botanical palæontology, that grasses and fruit-trees originated long subsequently to animals–all these are questions which, if I mistake not, would be answered decisively in the negative by those who are specially conversant with the sciences involved. And it must be recollected that the issue raised by Mr. Gladstone is not whether, by some effort of ingenuity, the pentateuchal story can be shown to be not disprovable by scientific knowledge, but whether it is supported thereby.

"There is nothing, then, in the criticisms of Dr. Revillé but what rather tends to confirm than to impair the old-fashioned belief that there is a revelation in the book of Genesis" (p. 694).

The form into which Mr. Gladstone has thought fit to throw this opinion leaves me in doubt as to its

substance. I do not understand how a hostile criticism can, under any circumstances, tend to confirm that which it attacks. If, however, Mr. Gladstone merely means to express his personal impression, "as one wholly destitute of that kind of knowledge which carries authority," that he [160] has destroyed the value of these criticisms, I have neither the wish nor the right to attempt to disturb his faith. On the other hand, I may be permitted to state my own conviction, that, so far as natural science is involved, M. Réville's observations retain the exact value they possessed before Mr. Gladstone attacked them.

Trusting that I have now said enough to secure the author of a wise and moderate disquisition upon a topic which seems fated to stir unwisdom and fanaticism to their depths, a fuller measure of justice than has hitherto been accorded to him, I retire from my self-appointed championship, with the hope that I shall not hereafter be called upon by M. Réville to apologise for damage done to his strong case by imperfect or impulsive advocacy. But, perhaps, I may be permitted to add a word or two, on my own account, in reference to the great question of the relations between science and religion; since it is one about which I have thought a good deal ever since I have been able to think at all; and about which I have ventured to express my views publicly, more than once, in the course of the last thirty years.

The antagonism between science and religion, about which we hear so much, appears to me to be purely factitious–fabricated, on the one hand, by short-sighted religious people who confound a [161] certain branch of science, theology, with religion; and, on the other, by equally short-sighted scientific people who forget that science takes for its province only that which is susceptible of clear intellectual comprehension; and that, outside the boundaries of that province, they must be content with imagination, with hope, and with ignorance.

It seems to me that the moral and intellectual life of the civilised nations of Europe is the product of that interaction, sometimes in the way of antagonism, sometimes in that of profitable interchange, of the Semitic and the Aryan races, which commenced with the dawn of history, when Greek and Phoenician came in contact, and has been continued by Carthaginian and Roman, by Jew and Gentile, down to the present day. Our art (except, perhaps, music) and our science are the contributions of the Aryan; but the essence of our religion is derived from the Semite. In the eighth century B.C., in the heart of a world of idolatrous polytheists, the Hebrew prophets put forth a conception of religion which appears to me to be as wonderful an inspiration of genius as the art of Pheidias or the science of Aristotle.

"And what doth the Lord require of thee, but to do justly, and to love mercy, and to walk humbly with thy God?"

If any so-called religion takes away from this great saying of Micah, I think it wantonly muti[162]lates, while, if it adds thereto, I think it obscures, the perfect ideal of religion.

But what extent of knowledge, what acuteness of scientific criticism, can touch this, if any one possessed of knowledge, or acuteness, could be absurd enough to make the attempt? Will the progress of research prove that justice is worthless and mercy hateful; will it ever soften the bitter contrast between our actions and our aspirations; or show us the bounds of the universe and bid us say, Go to, now we

comprehend the infinite? A faculty of wrath lay in those ancient Israelites, and surely the prophet's staff would have made swift acquaintance with the head of the scholar who had asked Micah whether, peradventure, the Lord further required of him an implicit belief in the accuracy of the cosmogony of Genesis!

What we are usually pleased to call religion nowadays is, for the most part, Hellenised Judaism; and, not unfrequently, the Hellenic element carries with it a mighty remnant of old-world paganism and a great infusion of the worst and weakest products of Greek scientific speculation; while fragments of Persian and Babylonian, or rather Accadian, mythology burden the Judaic contribution to the common stock.

The antagonism of science is not to religion, but to the heathen survivals and the bad philosophy under which religion herself is often well-[163]nigh crushed. And, for my part, I trust that this antagonism will never cease; but that, to the end of time, true science will continue to fulfil one of her most beneficent functions, that of relieving men from the burden of false science which is imposed upon them in the name of religion.

This is the work that M. Réville and men such as he are doing for us; this is the work which his opponents are endeavouring, consciously or unconsciously, to hinder.

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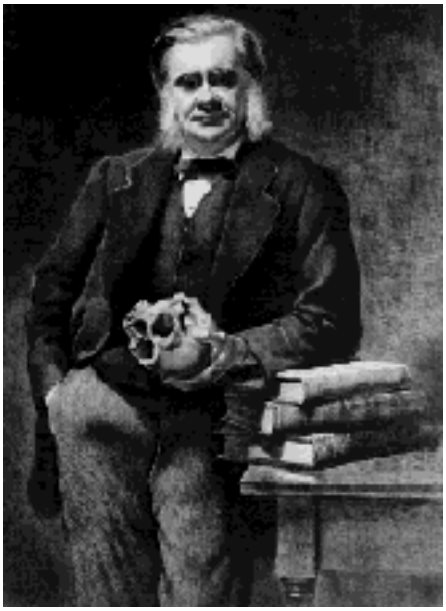
[1] *The Nineteenth Century.*

[2] [Earlier, if more recent announcements are correct.]

[3] It may be objected that I have not put the case fairly inasmuch as the solitary insect's wing which was discovered twelve months ago in Silurian rocks, and which is, at present, the sole evidence of insects older than the Devonian epoch, came from strata of Middle Silurian age, and is therefore older than the scorpions which, within the last two years, have been found in Upper Silurian strata in Sweden, Britain, and the United States. But no one who comprehends the nature of the evidence afforded by fossil remains would venture to say that the non-discovery of scorpions in the Middle Silurian strata, up to this time, affords any more ground for supposing that they did not exist, than the non-discovery of flying insects in the Upper Silurian strata, up to this time, throws any doubt on the certainty that they existed, which is derived from the occurrence of the wing in the Middle Silurian. In fact, I have stretched a point in admitting that these fossils afford a colourable pretext for the assumption that the land and air-population were of contemporaneous origin.

THE HUXLEY FILE



Preface and Table of Contents to Volume IV, *Science and Hebrew Tradition,* of Huxley's *Collected Essays.*

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Previous article: Lectures on Evolution [New York, 1876], pages 46-138.

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Mr. Gladstone and Genesis (1886)

Collected Essays IV

[164] In controversy, as in courtship, the good old rule to be off with the old before one is on with the new, greatly commends itself to my sense of expediency. And, therefore, it appears to me desirable that I should preface such observations as I may have to offer upon the cloud of arguments (the relevancy of which to the issue which I had ventured to raise is not always obvious) put forth by Mr. Gladstone in the January number of this review,[1] by an endeavour to make clear to such of our readers as have not had the advantage of a forensic education the present net result of the discussion.

I am quite aware that, in undertaking this task, I run all the risks to which the man who presumes to deal judicially with his own cause is liable. [165] But it is exactly because I do not shun that risk, but, rather, earnestly desire to be judged by him who cometh after me, provided that he has the knowledge and impartiality appropriate to a judge, that I adopt my present course.

In the article on "**The Dawn of Creation and of Worship**," it will be remembered that Mr. Gladstone unreservedly commits himself to three propositions. The first is that, according to the writer of the Pentateuch, the "water-population," the "air-population," and the "land-population" of the globe were created successively, in the order named. In the second place, Mr. Gladstone authoritatively asserts that this (as part of his "fourfold order") has been "so affirmed in our time by natural science, that it may be taken as a demonstrated conclusion and established fact." In the third place, Mr. Gladstone argues that the fact of this coincidence of the pentateuchal story with the results of modern investigation makes it "impossible to avoid the conclusion, first, that either this writer was gifted with faculties passing all human experience, or else his knowledge was divine." And having settled to his own satisfaction that the first "branch of the alternative is truly nominal and unreal," Mr. Gladstone continues, "So stands the plea for a revelation of truth from God, a plea only to be met by questioning its possibility" (p. 697).

I am a simple-minded person, wholly devoid of [166] subtlety of intellect, so that I willingly admit that there may be depths of alternative meaning in these propositions out of all soundings attainable by my poor plummet. Still there are a good many people who suffer under a like intellectual limitation; and, for once in my life, I feel that I have the chance of attaining that position of a representative of average opinion which appears to be the modern ideal of a leader of men, when I make free confession that, after turning the matter over in my mind, with all the aid derived from a careful consideration of Mr. Gladstone's reply, I cannot get away from my original conviction that, if Mr. Gladstone's second proposition can be shown to be not merely inaccurate, but directly contradictory of facts known to every one who is acquainted with the elements of natural science, the third proposition collapses of itself.

And it was this conviction which led me to enter upon the present discussion. I fancied that if my respected clients, the people of average opinion and capacity, could once be got distinctly to conceive that Mr. Gladstone's views as to the proper method of dealing with grave and difficult scientific and

religious problems had permitted him to base a solemn "plea for a revelation of truth from God" upon an error as to a matter of fact, from which the intelligent perusal of a manual of palæontology would have saved him, I need not trouble myself to occupy their time and attention [167] with further comments upon his contribution to apologetic literature. It is for others to judge whether I have efficiently carried out my project or not. It certainly does not count for much that I should be unable to find any flaw in my own case, but I think it counts for a good deal that Mr. Gladstone appears to have been equally unable to do so. He does, indeed, make a great parade of authorities, and I have the greatest respect for those authorities whom Mr. Gladstone mentions. If he will get them to sign a joint memorial to the effect that our present palæontological evidence proves that birds appeared before the "land-population" of terrestrial reptiles, I shall think it my duty to reconsider my position–but not till then.

It will be observed that I have cautiously used the word "appears" in referring to what seems to me to be absence of any real answer to my criticisms in Mr. Gladstone's reply. For I must honestly confess that, notwithstanding long and painful strivings after clear insight, I am still uncertain whether Mr. Gladstone's "Defence" means that the great "plea for a revelation from God" is to be left to perish in the dialectic desert; or whether it is to be withdrawn under the protection of such skirmishers as are available for covering retreat.

In particular, the remarkable disquisition which covers pages 11 to 14 of Mr. Gladstone's last contribution has greatly exercised my mind. [168] Socrates is reported to have said of the works of Heraclitus that he who attempted to comprehend them should be a "Delian swimmer," but that, for his part, what he could understand was so good that he was disposed to believe in the excellence of that which he found unintelligible. In endeavouring to make myself master of Mr. Gladstone's meaning in these pages, I have often been overcome by a feeling analogous to that of Socrates, but not quite the same. That which I do understand has appeared to me so very much the reverse of good, that I have sometimes permitted myself to doubt the value of that which I do not understand.

In this part of Mr. Gladstone's reply, in fact, I find nothing of which the bearing upon my arguments is clear to me, except that which relates to the question whether reptiles, so far as they are represented by tortoises and the great majority of lizards and snakes, which are land animals, are creeping things in the sense of the pentateuchal writer or not.

I have every respect for the singer of the Song of the Three Children (whoever he may have been); I desire to cast no shadow of doubt upon, but, on the contrary, marvel at, the exactness of Mr. Gladstone's information as to the considerations which "affected the method of the Mosaic writer"; nor do I venture to doubt that the inconvenient intrusion of these contemptible rep[169]tiles–"a family fallen from greatness" (p. 14), a miserable decayed aristocracy reduced to mere "skulkers about the earth" (*ibid.*)–in consequence, apparently, of difficulties about the occupation of land arising out of the earth-hunger of their former serfs, the mammals–into an apologetic argument, which otherwise would run quite smoothly, is in every way to be deprecated. Still, the wretched creatures stand there, importunately demanding notice; and, however different may be the practice in that contentious atmosphere with which Mr. Gladstone expresses and laments his familiarity, in the atmosphere of science it really is of no avail whatever to shut one's eyes to facts, or to try to bury them out of sight under a tumulus of rhetoric. That

is my experience of the "Elysian regions of Science," wherein it is a pleasure to me to think that a man of Mr. Gladstone's intimate knowledge of English life, during the last quarter of a century, believes my philosophic existence to have been rounded off in unbroken equanimity.

However reprehensible, and indeed contemptible, terrestrial reptiles may be, the only question which appears to me to be relevant to my argument is whether these creatures are or are not comprised under the denomination of "everything that creepeth upon the ground."

Mr. Gladstone speaks of the author of the first chapter of Genesis as "the Mosaic writer"; [170] I suppose, therefore, that he will admit that it is equally proper to speak of the author of Leviticus as the "Mosaic writer." Whether such a phrase would be used by any one who had an adequate conception of the assured results of modern Biblical criticism is another matter; but, at any rate, it cannot be denied that Leviticus has as much claim to Mosaic authorship as Genesis. Therefore, if one wants to know the sense of a phrase used in Genesis, it will be well to see what Leviticus has to say on the matter. Hence, I commend the following extract from the eleventh chapter of Leviticus to Mr. Gladstone's serious attention:–

"And these are they which are unclean unto you among the creeping things that creep upon the earth: the weasel, and the mouse, and the great lizard after its kind, and the gecko, and the land crocodile, and the sand-lizard, and the chameleon. These are they which are unclean to you among all that creep (v. 29-3l)."

The merest Sunday-school exegesis therefore suffices to prove that when the "Mosaic writer" in Genesis i. 24 speaks of "creeping things," he means to include lizards among them.

This being so, it is agreed, on all hands, that terrestrial lizards, and other reptiles allied to lizards, occur in the Permian strata. It is further agreed that the Triassic strata were deposited after these. Moreover, it is well known that, even if certain footprints are to be [171] taken as unquestionable evidence of the existence of birds, they are not known to occur in rocks earlier than the Trias, while indubitable remains of birds are to be met with only much later. Hence it follows that natural science does not "affirm" the statement that birds were made on the fifth day, and "everything that creepeth on the ground" on the sixth, on which Mr. Gladstone rests his order; for, as is shown by Leviticus, the "Mosaic writer" includes lizards among his "creeping things."

Perhaps I have given myself superfluous trouble in the preceding argument, for I find that Mr. Gladstone is willing to assume (he does not say to admit) that the statement in the text of Genesis as to reptiles cannot "in all points be sustained" (p. 16). But my position is that it cannot be sustained in any point, so that, after all, it has perhaps been as well to go over the evidence again. And then Mr. Gladstone proceeds as if nothing had happened to tell us that–

"There remain great unshaken facts to be weighed. First, the fact that such a record should have been made at all."

As most peoples have their cosmogonies, this "fact" does not strike me as having much value.

"Secondly, the fact that, instead of dwelling in generalities, it has placed itself under the severe conditions of a chronological order reaching from the first *nisus* of chaotic matter to the [172] consummated production of a fair and goodly, a furnished and a peopled world."

This "fact" can be regarded as of value only by ignoring the fact demonstrated in my previous paper, that natural science does not confirm the order asserted so far as living things are concerned; and by upsetting a fact to be brought to light presently, to wit, that, in regard to the rest of the pentateuchal cosmogony, prudent science has very little to say one way or the other.

"Thirdly, the fact that its cosmogony seems, in the light of the nineteenth century, to draw more and more of countenance from the best natural philosophy."

I have already questioned the accuracy of this statement, and I do not observe that mere repetition adds to its value.

"And, fourthly, that it has described the successive origins of the five great categories of present life with which human experience was and is conversant, in that order which geological authority confirms."

By comparison with a sentence on page 14, in which a fivefold order is substituted for the "fourfold order," on which the "plea for revelation" was originally founded, it appears that these five categories are "plants, fishes, birds, mammals, and man," which, Mr. Gladstone affirms, "are given to us in Genesis in the order of succession in which they are also given by the latest geological authorities."

[173] I must venture to demur to this statement. I showed, in my previous paper, that there is no reason to doubt that the term "great sea monster" (used in Gen. i. 21) includes the most conspicuous of great sea animals–namely, whales, dolphins, porpoises, manatees, and dugongs;[2] and, as these are indubitable mammals, it is impossible to affirm that mammals come after birds, which are said to have been created on the same day. Moreover, I pointed out that as these Cetacea and Sirenia are certainly modified land animals, their existence implies the antecedent existence of land mammals.

Furthermore, I have to remark that the term "fishes," as used, technically, in zoology, by no means covers all the moving creatures that have life, which are bidden to "fill the waters in the seas" (Gen. i. 20-22.) Marine mollusks and crustacea, echinoderms, corals, and foraminifera are not technically fishes. But they are abundant in the palæozoic rocks, ages upon ages older than those in which the first evidences of true fishes appear. And if, in a geological book, Mr. Gladstone finds the quite true statement that plants appeared before fishes, it is only by a complete misunderstanding that he can be led to imagine it serves his purpose. [174] As a matter of fact, at the present moment, it is a question whether, on the bare evidence afforded by fossils, the marine creeping thing or the marine plant has the seniority. No cautious palæontologist would express a decided opinion on the matter. But, if we are to read the pentateuchal statement as a scientific document (and, in spite of all protests to the contrary, those who bring it into comparison with science do seek to make a scientific document of it), then, as it is quite clear that only terrestrial plants of high organisation are spoken of in verses 11 and 12, no

palæontologist would hesitate to say that, at present, the records of sea animal life are vastly older than those of any land plant describable as "grass, herb yielding seed or fruit tree."

Thus, although, in Mr. Gladstone's "Defence," the "old order passeth into new," his case is not improved. The fivefold order is no more "affirmed in our time by natural science" to be "a demonstrated conclusion and established fact" than the fourfold order was. Natural science appears to me to decline to have anything to do with either; they are as wrong in detail as they are mistaken in principle.

There is another change of position, the value of which is not so apparent to me, as it may well seem to be to those who are unfamiliar with the subject under discussion. Mr. Gladstone [175] discards his three groups of "water-population," "air-population," and "land-population," and substitutes for them (1) fishes, (2) birds, (3) mammals, (4) man. Moreover, it is assumed, in a note, that "the higher or ordinary mammals" alone were known to the "Mosaic writer" (p. 6). No doubt it looks, at first, as if something were gained by this alteration; for, as I have just pointed out, the word "fishes" can be used in two senses, one of which has a deceptive appearance of adjustability to the "Mosaic" account. Then the inconvenient reptiles are banished out of sight; and, finally, the question of the exact meaning of "higher" and "ordinary" in the case of mammals opens up the prospect of a hopeful logomachy. But what is the good of it all in the face of Leviticus on the one hand and of palæontology on the other?

As, in my apprehension, there is not a shadow of justification for the suggestion that when the pentateuchal writer says "fowl" he excludes bats (which, as we shall see directly, are expressly included under "fowl" in Leviticus), and as I have already shown that he demonstrably includes reptiles, as well as mammals, among the creeping things of the land, I may be permitted to spare my readers further discussion of the "fivefold order." On the whole, it is seen to be rather more inconsistent with Genesis than its fourfold predecessor.

[176] But I have yet a fresh order to face. Mr. Gladstone (p. 11) understands "the main statements of Genesis in successive order of time, but without any measurement of its divisions, to be as follows:–

1. A period of land, anterior to all life (v. 9, 10).

2. A period of vegetable life, anterior to animal life (v. 11, 12).

3. A period of animal life, in the order of fishes (v. 20).

4. Another stage of animal life, in the order of birds.

5. Another in the order of beasts (v. 24, 25).

6. Last of all, man (v. 26, 27).

Mr. Gladstone then tries to find the proof of the occurrence of a similar succession in sundry excellent

works on geology.

I am really grieved to be obliged to say that this third (or is it fourth?) modification of the foundation of the "plea for revelation" originally set forth, satisfies me as little as any of its predecessors.

For, in the first place, I cannot accept the assertion that this order is to be found in Genesis. With respect to No. 5, for example, I hold, as I have already said, that "great sea monsters" includes the Cetacea, in which case mammals (which is what, I suppose, Mr. Gladstone means by "beasts ") come in under head No. 3, and not under No. 5. Again, "fowl" are said in Genesis to be created on the same day as fishes; therefore I cannot accept an order which makes birds [177] succeed fishes. Once more, as it is quite certain that the term "fowl" includes the bats,–for in Leviticus xi. 13-19 we read, "And these shall ye have in abomination among the fowls . . . the heron after its kind, and the hoopoe, and the bat,"–it is obvious that bats are also said to have been created at stage No. 3. And as bats are mammals, and their existence obviously presupposes that of terrestrial "beasts," it is quite clear that the latter could not have first appeared as No. 5. I need not repeat my reasons for doubting whether man came "last of all."

As the latter half of Mr. Gladstone's sixfold order thus shows itself to be wholly unauthorised by, and inconsistent with, the plain language of the Pentateuch, I might decline to discuss the admissibility of its former half.

But I will add one or two remarks on this point also. Does Mr. Gladstone mean to say that in any of the works he has cited, or indeed anywhere else, he can find scientific warranty for the assertion that there was a period of land–by which I suppose he means dry land (for submerged land must needs be as old as the separate existence of the sea)–"anterior to all life?"

It may be so, or it may not be so; but where is the evidence which would justify any one in making a positive assertion on the subject? What competent palæontologist will affirm, at this present moment, that he knows anything about [178] the period at which life originated, or will assert more than the extreme probability that such origin was a long way antecedent to any traces of life at present known? What physical geologist will affirm that he knows when dry land began to exist, or will say more than that it was probably very much earlier than any extant direct evidence of terrestrial conditions indicates?

I think I know pretty well the answers which the authorities quoted by Mr. Gladstone would give to these questions; but I leave it to them to give them if they think fit.

If I ventured to speculate on the matter at all, I should say it is by no means certain that sea is older than dry land, inasmuch as a solid terrestrial surface may very well have existed before the earth was cool enough to allow of the existence of fluid water. And, in this case, dry land may have existed before the sea. As to the first appearance of life, the whole argument of analogy, whatever it may be worth in such a case, is in favour of the absence of living beings until long after the hot water seas had constituted themselves; and of the subsequent appearance of aquatic before terrestrial forms of life. But whether these "protoplasts" would, if we could examine them, be reckoned among the lowest microscopic algæ,

or fungi; or among those doubtful organisms which lie in the debatable land between animals and plants, is, in my judgment, [179] a question on which a prudent biologist will reserve his opinion.

I think that I have now disposed of those parts of Mr. Gladstone's defence in which I seem to discover a design to rescue his solemn "plea for revelation." But a great deal of the "Proem to Genesis" remains which I would gladly pass over in silence, were such a course consistent with the respect due to so distinguished a champion of the "reconcilers."

I hope that my clients–the people of average opinions–have by this time some confidence in me; for when I tell them that, after all, Mr. Gladstone is of opinion that the "Mosaic record" was meant to give moral, and not scientific, instruction to those for whom it was written, they may be disposed to think that I must be misleading them. But let them listen further to what Mr. Gladstone says in a compendious but not exactly correct statement respecting my opinions:–

"He holds the writer responsible for scientific precision: I look for nothing of the kind, but assign to him a statement general, which admits exceptions; popular, which aims mainly at producing moral impression; summary, which cannot but be open to more or less of criticism of detail. He thinks it is a lecture. I think it is a sermon" (p. 5).

I note, incidentally, that Mr. Gladstone appears to consider that the *differentia* between a lecture [180] and a sermon is, that the former, so far as it deals with matters of fact, may be taken seriously, as meaning exactly what it says, while a sermon may not. I have quite enough on my hands without taking up the cudgels for the clergy, who will probably find Mr. Gladstone's definition unflattering.

But I am diverging from my proper business, which is to say that I have given no ground for the ascription of these opinions; and that, as a matter of fact, I do not hold them and never have held them. It is Mr. Gladstone, and not I, who will have it that the pentateuchal cosmogony is to be taken as science.

My belief, on the contrary, is, and long has been, that the pentateuchal story of the creation is simply a myth. I suppose it to be an hypothesis respecting the origin of the universe which some ancient thinker found himself able to reconcile with his knowledge, or what he thought was knowledge, of the nature of things, and therefore assumed to be true. As such, I hold it to be not merely an interesting, but a venerable, monument of a stage in the mental progress of mankind; and I find it difficult to suppose that any one who is acquainted with the cosmogonies of other nations–and especially with those of the Egyptians and the Babylonians, with whom the Israelites were in such frequent and intimate communication–should consider it to possess [181] either more, or less, scientific importance than may be allotted to these.

Mr. Gladstone's definition of a sermon permits me to suspect that he may not see much difference between that form of discourse and what I call a myth; and I hope it may be something more than the slowness of apprehension, to which I have confessed, which leads me to imagine that a statement which is "general" but "admits exceptions," which is "popular" and "aims mainly at producing moral impression," "summary" and therefore open to "criticism of detail," amounts to a myth, or perhaps less

than a myth. Put algebraically, it comes to this, $x = a + b + c$; always remembering that there is nothing to show the exact value of either *a*, or *b*, or *c*. It is true that *a* is commonly supposed to equal 10, but there are exceptions, and these may reduce it to 8, or 3, or 0; *b* also popularly means 10, but being chiefly used by the algebraist as a "moral" value, you cannot do much with it in the addition or subtraction of mathematical values; *c* also is quite "summary," and if you go into the details of which it is made up, many of them may be wrong, and their sum total equal to 0, or even to a minus quantity.

Mr. Gladstone appears to wish that I should (1) enter upon a sort of essay competition with the author of the pentateuchal cosmogony; (2) that I should make a further statement about some elementary facts in the history of Indian and Greek [182] philosophy; and (3) that I should show cause for my hesitation in accepting the assertion that Genesis is supported, at any rate to the extent of the first two verses, by the nebular hypothesis.

A certain sense of humour prevents me from accepting the first invitation. I would as soon attempt to put Hamlet's soliloquy into a more scientific shape. But if I supposed the "Mosaic writer" to be inspired, as Mr. Gladstone does, it would not be consistent with my notions of respect for the Supreme Being to imagine Him unable to frame a form of words which should accurately, or, at least, not inaccurately, express His own meaning. It is sometimes said that, had the statements contained in the first chapter of Genesis been scientifically true, they would have been unintelligible to ignorant people; but how is the matter mended if, being scientifically untrue, they must needs be rejected by instructed people?

With respect to the second suggestion, it would be presumptuous in me to pretend to instruct Mr. Gladstone in matters which lie as much within the province of Literature and History as in that of Science; but if any one desirous of further knowledge will be so good as to turn to that most excellent and by no means recondite source of information, the "Encyclopædia Britannica," he will find, under the letter E, the word "Evolution," and a long article on that subject. Now, I do not recommend him to read the first half of the [183] article; but the second half, by my friend Mr. Sully, is really very good. He will there find it said that in some of the philosophies of ancient India, the idea of evolution is clearly expressed: "Brahma is conceived as the eternal self-existent being, which, on its material side, unfolds itself to the world by gradually condensing itself to material objects through the gradations of ether, fire, water, earth, and other elements." And again: "In the later system of emanation of Sankhya there is a more marked approach to a materialistic doctrine of evolution." What little knowledge I have of the matter–chiefly derived from that very instructive book, "Die Religion des Buddha," by C. F. Koeppen, supplemented by Hardy's interesting works–leads me to think that Mr. Sully might have spoken much more strongly as to the evolutionary character of Indian philosophy, and especially of that of the Buddhists. But the question is too large to be dealt with incidentally.

And, with respect to early Greek philosophy,[3] the seeker after additional enlightenment need go no further than the same excellent storehouse of information:–

"The early Ionian physicists, including Thales, Anaximander, and Anaximenes, seek to explain the world as generated out of [184] a primordial matter which is at the same time the universal support of things. This

substance is endowed with a generative or transmutative force by virtue of which it passes into a succession of forms. They thus resemble modern evolutionists since they regard the world, with its infinite variety of forms, as issuing from a simple mode of matter."

Further on, Mr. Sully remarks that "Heraclitus deserves a prominent place in the history of the idea of evolution," and he states, with perfect justice, that Heraclitus has foreshadowed some of the special peculiarities of Mr. Darwin's views. It is indeed a very strange circumstance that the philosophy of the great Ephesian more than adumbrates the two doctrines which have played leading parts, the one in the development of Christian dogma, the other in that of natural science. The former is the conception of the word [logos] which took its Jewish shape in Alexandria, and its Christian form[4] in that Gospel which is usually referred to an Ephesian source of some five centuries later date; and the latter is that of the struggle for existence. The saying that "strife is father and king of all" [...], ascribed to Heraclitus, would be a not inappropriate motto for the "Origin of Species."

I have referred only to Mr. Sully's article, because his authority is quite sufficient for my purpose. But the consultation of any of the more elaborate histories of Greek philosophy, such as [185] the great work of Zeller, for example, will only bring out the same fact into still more striking prominence. I have professed no "minute acquaintance" with either Indian or Greek philosophy, but I have taken a great deal of pains to secure that such knowledge as I do possess shall be accurate and trustworthy.

In the third place, Mr. Gladstone appears to wish that I should discuss with him the question whether the nebular hypothesis is, or is not, confirmatory of the pentateuchal account of the origin of things. Mr. Gladstone appears to be prepared to enter upon this campaign with a light heart. I confess I am not, and my reason for this backwardness will doubtless surprise Mr. Gladstone. It is that, rather more than a quarter of a century ago (namely, in February 1859), when it was my duty, as President of the Geological Society, to deliver the Anniversary Address,[5] I chose a topic which involved a very careful study of the remarkable cosmogonical speculation, originally promulgated by Immanuel Kant and, subsequently, by Laplace, which is now known as the nebular hypothesis. With the help of such little acquaintance with the principles of physics and astronomy as I had gained, I endeavoured to obtain a clear understanding of this speculation in all its bearings. I am not sure that I succeeded; but of this I am certain, that the problems involved [186] are very difficult, even for those who possess the intellectual discipline requisite for dealing with them. And it was this conviction that led me to express my desire to leave the discussion of the question of the asserted harmony between Genesis and the nebular hypothesis to experts in the appropriate branches of knowledge. And I think my course was a wise one; but as Mr. Gladstone evidently does not understand how there can be any hesitation on my part, unless it arises from a conviction that he is in the right, I may go so far as to set out my difficulties.

They are of two kinds–exegetical and scientific. It appears to me that it is vain to discuss a supposed coincidence between Genesis and science unless we have first settled, on the one hand, what Genesis says, and, on the other hand, what science says.

In the first place, I cannot find any consensus among Biblical scholars as to the meaning of the words,

"In the beginning God created the heaven and the earth." Some say that the Hebrew word *bara,* which is translated "create," means "made out of nothing." I venture to object to that rendering, not on the ground of scholarship, but of common sense. Omnipotence itself can surely no more make something "out of" nothing than it can make a triangular circle. What is intended by "made out of nothing" appears to be "caused to come into existence," with the implication that [187] nothing of the same kind previously existed. It is further usually assumed that "the heaven and the earth" means the material substance of the universe. Hence the "Mosaic writer" is taken to imply that where nothing of a material nature previously existed, this substance appeared. That is perfectly conceivable, and therefore no one can deny that it may have happened. But there are other very authoritative critics who say that the ancient Israelite[6] who wrote the passage was not likely to have been capable of such abstract thinking; and that, as a matter of philology, *bara* is commonly used to signify the "fashioning," or "forming," of that which already exists. Now it appears to me that the scientific investigator is wholly incompetent to say anything at all about the first origin of the material universe. The whole power of his organon vanishes when he has to step beyond the chain of natural causes and effects. No form of the nebular hypothesis, that I know of, is necessarily connected with any view of the origination of the nebular substance. Kant's form of it expressly supposes that the nebular material from which one stellar system starts may be nothing but the disintegrated substance of a stellar and planetary system which has just come [188] to an end. Therefore, so far as I can see, one who believes that matter has existed from all eternity has just as much right to hold the nebular hypothesis as one who believes that matter came into existence at a specified epoch. In other words, the nebular hypothesis and the creation hypothesis, up to this point, neither confirm nor oppose one another.

Next, we read in the revisers' version, in which I suppose the ultimate results of critical scholarship to be embodied: "And the earth was waste ['without form,' in the Authorised Version] and void." Most people seem to think that this phraseology intends to imply that the matter out of which the world was to be formed was a veritable "chaos," devoid of law and order. If this interpretation is correct, the nebular hypothesis can have nothing to say to it. The scientific thinker cannot admit the absence of law and order; anywhere or anywhen, in nature. Sometimes law and order are patent and visible to our limited vision; sometimes they are hidden. But every particle of the matter of the most fantastic-looking nebula in the heavens is a realm of law and order in itself; and, that it is so, is the essential condition of the possibility of solar and planetary evolution from the apparent chaos.[7]

[189] "Waste" is too vague a term to be worth consideration. "Without form," intelligible enough as a metaphor, if taken literally is absurd; for a material thing existing in space must have a superficies, and if it has a superficies it has a form. The wildest streaks of marestail clouds in the sky, or the most irregular heavenly nebulæ, have surely just as much form as a geometrical tetrahedron; and as for "void," how can that be void which is full of matter? As poetry, these lines are vivid and admirable; as a scientific statement, which they must be taken to be if any one is justified in comparing them with another scientific statement, they fail to convey any intelligible conception to my mind.

The account proceeds: "And darkness was upon the face of the deep." So be it; but where, then, is the likeness to the celestial nebulæ, of the existence of which we should know nothing unless they shone

with a light of their own? "And the spirit of God moved upon the face of the waters." I have met with no form of the nebular hypothesis which involves anything analogous to this process.

I have said enough to explain some of the difficulties which arise in my mind, when I try to ascertain whether there is any foundation for the contention that the statements contained in the first two verses of Genesis are supported by the nebular hypothesis. The result does not appear to me to be exactly favourable to that contention. [190] The nebular hypothesis assumes the existence of matter, having definite properties, as its foundation. Whether such matter was created a few thousand years ago, or whether it has existed through an eternal series of metamorphoses of which our present universe is only the last stage, are alternatives, neither of which is scientifically untenable, and neither scientifically demonstrable. But science knows nothing of any stage in which the universe could be said, in other than a metaphorical and popular sense, to be formless or empty; or in any respect less the seat of law and order than it is now. One might as well talk of a fresh-laid hen's egg being "without form and void," because the chick therein is potential and not actual, as apply such terms to the nebulous mass which contains a potential solar system.

Until some further enlightenment comes to me, then, I confess myself wholly unable to understand the way in which the nebular hypothesis is to be converted into an ally of the "Mosaic writer."[8]

[191] But Mr. Gladstone informs us that Professor Dana and Professor Guyot are prepared to prove that the "first or cosmogonical portion of the Proem not only accords with, but teaches, the nebular hypothesis." There is no one to whose authority on geological questions I am more readily disposed to bow than that of my eminent friend Professor Dana. But I am familiar with what he has previously said on this topic in his well-known and standard work, into which, strangely enough, it does not seem to have occurred to Mr. Gladstone to look before he set out upon his present undertaking; and unless Professor Dana's latest contribution (which I have not yet met with) takes up altogether new ground, I am afraid I shall not be able to extricate myself, by its help, from my present difficulties.

It is a very long time since I began to think about the relations between modern scientifically ascertained truths and the cosmogonical speculations of the writer of Genesis; and, as I think that Mr. Gladstone might have been able to put his case with a good deal more force, if he had thought it worth while to consult the last chapter of Professor Dana's admirable "Manual of Geology," so I think he might have been made aware that [192] he was undertaking an enterprise of which he had not counted the cost, if he had chanced upon a discussion of the subject which I published in 1877.[9]

Finally, I should like to draw the attention of those who take interest in these topics to the weighty words of one of the most learned and moderate of Biblical critics:–

"A propos de cette première page de la Bible, on a coutume de nos jours de disserter, à perte de vue, sur l'accord du récit mosaïque avec les sciences naturelles; et comme celles-ci tout éloignées qu'elles sont encore de la perfection absolue, ont rendu populaires et en quelque sorte irréfragables un certain nombre de faits généraux ou de thèses fondamentales de la cosmologie et de la géologie, c'est le texte sacré qu'on s'évertue à torturer pour le

faire concorder avec ces données."[10]

In my paper on the "Interpreters of Nature and the Interpreters of Genesis," while freely availing myself of the rights of a scientific critic, I endeavoured to keep the expression of my views well within those bounds of courtesy which are set by self-respect and consideration for others. I am therefore glad to be favoured with Mr. Gladstone's acknowledgment of the success of my efforts. I only wish that I could accept all the products of Mr. Gladstone's gracious appreciation, but there is one about which, as a matter of honesty, I hesitate. In fact, if I had expressed my [193] meaning better than I seem to have done, I doubt if the particular proffer of Mr. Gladstone's thanks would have been made.

To my mind, whatever doctrine professes to be the result of the application of the accepted rules of inductive and deductive logic to its subject-matter; and which accepts, within the limits which it sets to itself, the supremacy of reason, is Science. Whether the subject-matter consists of realities or unrealities, truths or falsehoods, is quite another question. I conceive that ordinary geometry is science, by reason of its method, and I also believe that its axioms, definitions, and conclusions are all true. However, there is a geometry of four dimensions, which I also believe to be science, because its method professes to be strictly scientific. It is true that I cannot conceive four dimensions in space, and therefore, for me, the whole affair is unreal. But I have known men of great intellectual powers who seemed to have no difficulty either in conceiving them, or, at any rate, in imagining how they could conceive them; and, therefore, four-dimensioned geometry comes under my notion of science. So I think astrology is a science, in so far as it professes to reason logically from principles established by just inductive methods. To prevent misunderstanding, perhaps I had better add that I do not believe one whit in astrology; but no more do I believe in Ptolemaic astronomy, or in the catastrophic [194] geology of my youth, although these, in their day, claimed–and, to my mind, rightly claimed–the name of science. If nothing is to be called science but that which is exactly true from beginning to end, I am afraid there is very little science in the world outside mathematics. Among the physical sciences, I do not know that any could claim more than that it is true within certain limits, so narrow that, for the present at any rate, they may be neglected. If such is the case, I do not see where the line is to be drawn between exactly true, partially true, and mainly untrue forms of science. And what I have said about the current theology at the end of my paper [*suprà* pp. 160-163] leaves, I think, no doubt as to the category in which I rank it. For all that, I think it would be not only unjust, but almost impertinent, to refuse the name of science to the "Summa" of St. Thomas or to the "Institutes" of Calvin.

In conclusion, I confess that my supposed "unjaded appetite" for the sort of controversy in which it needed not Mr. Gladstone's express declaration to tell us he is far better practised than I am (though probably, without another express declaration, no one would have suspected that his controversial fires are burning low) is already satiated.

In "Elysium" we conduct scientific discussions in a different medium, and we are liable to threat[195]enings of asphyxia in that "atmosphere of contention" in which Mr. Gladstone has been able to live, alert and vigorous beyond the common race of men, as if it were purest mountain air. I trust that he may long continue to seek truth, under the difficult conditions he has chosen for the search, with unabated

energy–I had almost said fire–

> May age not wither him, nor custom stale
> His infinite variety.

But Elysium suits my less robust constitution better, and I beg leave to retire thither, not sorry for my experience of the other region–no one should regret experience–but determined not to repeat it, at any rate in reference to the "plea for revelation."

Note on the Proper Sense of the "Mosaic" Narrative of the Creation

It has been objected to my argument from Leviticus (*suprà* p. 170) that the Hebrew words translated by "creeping things" in Genesis i. 24 and Leviticus xi. 29, are different; namely, "reh-mes" in the former, "sheh-retz" in the latter. The obvious reply to this objection is that the question is not one of words but of the meaning of words. To borrow an illustration from our own language, if "crawling things" had been used by the translators in Genesis and "creeping things" in Leviticus, it would not have been necessarily implied that they intended to denote different groups of animals. "Sheh-retz" is employed in a wider sense than "reh-mes." There are "sheh-retz" of the [196] waters of the earth, of the air, and of the land. Leviticus speaks of land reptiles, among other animals, as "sheh-retz"; Genesis speaks of all creeping land animals, among which land reptiles are necessarily included, as "reh-mes." Our translators, therefore, have given the true sense when they render both "sheh-retz" and "reh-mes" by "creeping things."

Having taken a good deal of trouble to show what Genesis i.-ii. 4 does not mean, in the preceding pages, perhaps it may be well that I should briefly give my opinion as to what it does mean. I conceive that the unknown author of this part of the Hexateuchal compilation believed, and meant his readers to believe, that his words, as they understood them–that is to say, in their ordinary natural sense–conveyed the "actual historical truth." When he says that such and such things happened, I believe him to mean that they actually occurred and not that he imagined or dreamed them; when he says "day," I believe he uses the word in the popular sense; when he says "made" or "created," I believe he means that they came into being by a process analogous to that which the people whom he addressed called "making" or "creating"; and I think that, unless we forget our present knowledge of nature, and, putting ourselves back into the position of a Phœnician or a Chaldæan philosopher, start from his conception of the world, we shall fail to grasp the meaning of the Hebrew writer. We must conceive the earth to be an immovable, more or less flattened, body, with the vault of heaven above, the watery abyss below and around. We must imagine sun, moon, and stars to be "set" in a "firmament" with, or in, which they move; and above which is yet another watery mass. We must consider "light" and "darkness" to be things, the alternation of which constitutes day and night, independently of the existence of sun, moon, and stars. We must further suppose that, as in the case of the story of the deluge, the Hebrew writer was acquainted with a Gentile (probably Chaldæan or Accadian) account of the origin of things, in which he substantially believed, but which he stripped of all its idolatrous associations by substituting "Elohim" for Ea, Anu, Bel, and the like.

From this point of view the first verse strikes the keynote [197] of the whole. In the beginning "Elohim[11] created the heaven and the earth." Heaven and earth were not primitive existences from which the gods proceeded, as the Gentiles taught; on the contrary, the "Powers" preceded and created heaven and earth. Whether by "creation" is meant "causing to be where nothing was before" or "shaping of something which pre-existed," seems to me to be an insoluble question.

As I have pointed out, the second verse has an interesting parallel in Jeremiah iv. 23: "I beheld the earth, and, lo, it was waste and void; and the heavens, and they had no light." I conceive that there is no more allusion to chaos in the one than in the other. The earth-disk lay in its watery envelope, like the yolk of an egg in the *glaire*, and the spirit, or breath, of Elohim stirred the mass. Light was created as a thing by itself; and its antithesis "darkness" as another thing. It was supposed to be the nature of these two to alternate, and a pair of alternations constituted a "day" in the sense of an unit of time.

The next step was, necessarily, the formation of that "firmament," or dome over the earth-disk, which was supposed to support the celestial waters; and in which sun, moon, and stars were conceived to be set, as in a sort of orrery. The earth was still surrounded and covered by the lower waters, but the upper were separated from it by the "firmament," beneath which what we call the air lay. A second alternation of darkness and light marks the lapse of time.

After this, the waters which covered the earth-disk, under the firmament, were drawn away into certain regions, which became seas, while the part laid bare became dry land. In accordance with the notion, universally accepted in antiquity, that moist earth possesses the potentiality of giving rise to living beings, the land, at the command of Elohim, "put forth" all sorts of plants. They are made to appear thus early, not, I apprehend, from any notion that plants are lower in the scale of being than animals (which would seem to be inconsistent with the prevalence of tree worship among ancient people), but rather because [198] animals obviously depend on plants; and because, without crops and harvests, there seemed to be no particular need of heavenly signs for the seasons.

These were provided by the fourth day's work. Light existed already; but now vehicles for the distribution of light, in a special manner and with varying degrees of intensity, were provided. I conceive that the previous alternations of light and darkness were supposed to go on; but that the "light" was strengthened during the daytime by the sun, which, as a source of heat as well as of light, glided up the firmament from the east, and slid down in the west, each day. Very probably each day's sun was supposed to be a new one. And as the light of the day was strengthened by the sun, so the darkness of the night was weakened by the moon, which regularly waxed and waned every month. The stars are, as it were, thrown in. And nothing can more sharply mark the doctrinal purpose of the author, than the manner in which he deals with the heavenly bodies, which the Gentiles identified so closely with their gods, as if they were mere accessories to the almanac.

Animals come next in order of creation, and the general notion of the writer seems to be that they were produced by the medium in which they live; that is to say, the aquatic animals by the waters, and the terrestrial animals by the land. But there was a difficulty about flying things, such as bats, birds, and insects. The cosmogonist seems to have had no conception of "air" as an elemental body. His "elements" are earth and water, and he ignores air as much as he does fire. Birds "fly above the earth in the open firmament" or "on the face of the expanse" of heaven. They are not said to fly through the air. The choice of a generative medium for flying things, therefore, seemed to lie between water and earth; and, if we take into account the conspicuousness of the great flocks of water-birds and the swarms of winged insects, which appear to arise from water, I think the preference of water becomes intelligible. However, I do not put this forward as more than a probable hypothesis. As to the creation of aquatic animals on the fifth, that of land animals on the sixth day, and that of man last of all, I presume the order was determined by the fact that man [199] could hardly receive dominion over the living world before it existed; and that the "cattle" were not wanted until he was about to make his appearance. The other terrestrial animals would naturally be associated with the cattle.

The absurdity of imagining that any conception, analogous to that of a zoological classification, was in the mind of the writer will be apparent, when we consider that the fifth day's work must include the zoologist's *Cetacea*, *Sirenia*, and seals,[12] all of which are *Mammalia;* all birds, turtles, sea-snakes and, presumably, the fresh water *Reptilia* and *Amphibia;* with the great majority of *Invertebrata*.

The creation of man is announced as a separate act, resulting from a particular resolution of Elohim to "make man in our image, after our likeness." To learn what this remarkable phrase means we must turn to the fifth chapter of Genesis, the work of the same writer. "In the day that Elohim created man, in the likeness of Elohim made he him; male and female created he them; and blessed them and called their name Adam in the day when they were created. And Adam lived an hundred and thirty years and begat *a son* in his own likeness, after his image; and called his name Seth." I find it impossible to read this passage without being convinced that, when the writer says Adam was made in the likeness of Elohim, he means the same sort of likeness as when he says that Seth was begotten in the likeness of Adam. Whence it follows that his conception of Elohim was completely anthropomorphic.

In all this narrative I can discover nothing which differentiates it, in principle, from other ancient cosmogonies, except the rejection of all gods, save the vague, yet anthropomorphic, Elohim, and the assigning to them anteriority and superiority to the world. It is as utterly irreconcilable with the assured truths of modern science, as it is with the account of the origin of man, plants, and animals given by the writer of the second chief constituent of the Hexateuch in the second chapter of Genesis. This extraordinary story starts with the assumption of the existence of a rainless earth, devoid of plants and herbs [200] of the field. The creation of living beings begins with that of a solitary man; the next thing that happens is the laying out of the Garden of Eden, and the causing the growth from its soil of every tree "that is pleasant to the sight and good for food"; the third act is the formation out of the ground of "every beast of the field, and every fowl of the air"; the fourth and last, the manufacture of the first woman from a rib, extracted from Adam, while in a state of anæsthesia.

Yet there are people who not only profess to take this monstrous legend seriously, but who declare it to be reconcilable with the Elohistic account of the creation!

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[1] *The Nineteenth Century*, 1886.

[2] Both dolphins and dugongs occur in the Red Sea, porpoises and dolphins in the Mediterranean; so that the "Mosaic writer" may have been acquainted with them.

[3] I said nothing about "the greater number of schools of Greek philosophy," as Mr. Gladstone implies that I did, but expressly spoke of the "founders of Greek philosophy."

[4] See Heinze, *Die Lehre vom Logos*, p. 9 *et seq.*

[5] Reprinted in *Lay Sermons, Addresses, and Reviews*, 1870.

[6] "Ancient," doubtless, but his antiquity must not be exaggerated. For example, there is no proof that the "Mosaic" cosmogony was known to the Israelites of Solomon's time.

[7] When Jeremiah (iv. 23) says, "I beheld the earth, and, lo, it was waste and void," he certainly does not mean to imply that the form of the earth was less definite, or its substance less solid, than before.

[8] In looking through the delightful volume recently published by the Astronomer-Royal for Ireland, a day or two ago, I find the following remarks on the nebular hypothesis, which I should have been glad to quote in my text if I had known them sooner:–

"Nor can it be ever more than a speculation; it cannot be established by observation, nor can it be proved by calculation. It is merely a conjecture, more or less plausible, but perhaps in some degree, necessarily true, if our present laws of heat, as we understand them, admit of the extreme application here required, and if the present order of things has reigned for sufficient time without the intervention of any influence at present known to us" (*The Story of the Heavens,* p. 506).

Would any prudent advocate base a plea, either for or against revelation, upon the coincidence, or want of coincidence, of the declarations of the latter with the requirements of an hypothesis thus guardedly dealt with by an astronomical expert?

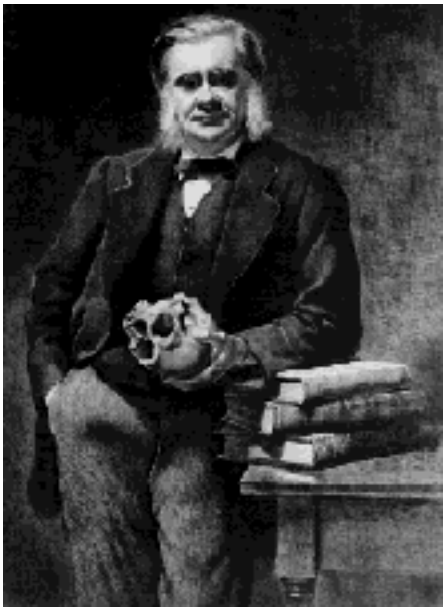
[9] Lectures on Evolution delivered in New York (American Addresses).

[10] Reuss, *L'Histoire Sainte et la Loi,* vol. i, p. 275.

[11] For the sense of the term "Elohim," see the essay entitled "The Evolution of Theology" at the end of this volume.

[12] Perhaps even hippopotamuses and otters!

THE HUXLEY FILE



Preface and Table of Contents to Volume IV, *Science and Hebrew Tradition,* of Huxley's *Collected Essays.*

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The Lights of the Church and the Light of Science (1890)

Collected Essays IV

[201] There are three ways of regarding any account of past occurrences, whether delivered to us orally or recorded in writing.

The narrative may be exactly true. That is to say, the words, taken in their natural sense, and interpreted according to the rules of grammar, may convey to the mind of the hearer, or of the reader an idea precisely correspondent with one which would have remained in the mind of a witness. For example, the statement that King Charles the First was beheaded at Whitehall on the 30th day of January 1649, is as exactly true as any proposition in mathematics or physics; no one doubts that any person of sound faculties, properly placed, who was present at Whitehall throughout that day, and who used his eyes, would have seen the [202] King's head cut off; and that there would have remained in his mind an idea of that occurrence which he would have put into words of the same value as those which we use to express it.

Or the narrative may be partly true and partly false. Thus, some histories of the time tell us what the King said, and what Bishop Juxon said; or report royalist conspiracies to effect a rescue; or detail the motives which induced the chiefs of the Commonwealth to resolve that the King should die. One account declares that the King knelt at a high block, another that he lay down with his neck on a mere plank. And there are contemporary pictorial representations of both these modes of procedure. Such narratives, while veracious as to the main event, may and do exhibit various degrees of unconscious and conscious misrepresentation, suppression, and invention, till they become hardly distinguishable from pure fictions. Thus, they present a transition to narratives of a third class, in which the fictitious element predominates. Here, again, there are all imaginable gradations, from such works as Defoe's quasi-historical account of the Plague year, which probably gives a truer conception of that dreadful time than any authentic history, through the historical novel, drama, and epic, to the purely phantasmal creations of imaginative genius, such as the old "Arabian Nights" or the modern "Shaving of Shagpat." It is not strictly needful for my present [203] purpose that I should say anything about narratives which are professedly fictitious. Yet it may be well, perhaps, if I disclaim any intention of derogating from their value, when I insist upon the paramount necessity of recollecting that there is no sort of relation between the ethical, or the æsthetic, or even the scientific importance of such works, and their worth as historical documents. Unquestionably, to the poetic artist, or even to the student of psychology, "Hamlet" and "Macbeth" may be better instructors than all the books of a wilderness of professors of æsthetics or of moral philosophy. But, as evidence of occurrences in Denmark, or in Scotland, at the times and places indicated, they are out of court; the profoundest admiration for them, the deepest gratitude for their influence, are consistent with the knowledge that, historically speaking, they are worthless fables, in which any foundation of reality that may exist is submerged beneath the imaginative superstructure.

At present, however, I am not concerned to dwell upon the importance of fictitious literature and the

immensity of the work which it has effected in the education of the human race. I propose to deal with the much more limited inquiry: Are there two other classes of consecutive narratives (as distinct from statements of individual facts), or only one? Is there any known historical work which is throughout exactly true, or is there not? In the case of the great majority [204] of histories the answer is not doubtful: they are all only partially true. Even those venerable works which bear the names of some of the greatest of ancient Greek and Roman writers, and which have been accepted by generation after generation, down to modern times, as stories of unquestionable truth, have been compelled by scientific criticism, after a long battle, to descend to the common level, and to confession to a large admixture of error. I might fairly take this for granted; but it may be well that I should entrench myself behind the very apposite words of a historical authority who is certainly not obnoxious to even a suspicion of sceptical tendencies.

"Time was–and that not very long ago–when all the relations of ancient authors concerning the old world were received with a ready belief; and an unreasoning and uncritical faith accepted with equal satisfaction the narrative of the campaigns of Cæsar and of the doings of Romulus, the account of Alexander's marches and of the conquests of Semiramis. We can most of us remember when, in this country, the whole story of regal Rome, and even the legend of the Trojan settlement in Latium, were seriously placed before boys as history, and discoursed of as unhesitatingly and in as dogmatic a tone as the tale of the Catilline Conspiracy or the Conquest of Britain. . .

But all this is now changed. The last century has seen the birth and growth of a new science–the Science of Historical Criticism. . . . The whole world of profane history has been revolutionised. . . ."[1]

[205] If these utterances were true when they fell from the lips of a Bampton lecturer in 1859, with how much greater force do they appeal to us now, when the immense labours of the generation now passing away constitute one vast illustration of the power and fruitfulness of scientific methods of investigation in history, no less than in all other departments of knowledge.

At the present time, I suppose, there is no one who doubts that histories which appertain to any other people than the Jews, and their spiritual progeny in the first century, fall within the second class of the three enumerated. Like Goethe's Autobiography, they might all be entitled "Wahrheit und Dichtung"–"Truth and Fiction." The proportion of the two constituents changes indefinitely; and the quality of the fiction varies through the whole gamut of unveracity. But "Dichtung" is always there. For the most acute and learned of historians cannot remedy the imperfections of his sources of information; nor can the most impartial wholly escape the influence of the "personal equation" generated by his temperament and by his education. Therefore, from the narratives of Herodotus to those set forth in yesterday's "Times," all history is to be read subject to the warning that fiction has its share therein. The modern vast development of fugitive literature cannot be the unmitigated evil that some do vainly say it is, since it has put an end to the popular delusion of [206] less press-ridden times, that what appears in print must be true. We should rather hope that some beneficent influence may create among the erudite a like healthy suspicion of manuscripts and inscriptions, however ancient; for a bulletin may lie, even though it be written in cuneiform characters. Hotspur's starling, that was to be taught to speak nothing but "Mortimer" into the ears of King Henry the Fourth, might be a useful inmate of every historian's library, if "Fiction" were substituted for the name of Harry Percy's friend.

But it was the chief object of the lecturer to the congregation gathered in St. Mary's, Oxford, thirty-one years ago, to prove to them, by evidence gathered with no little labour and marshalled with much skill, that one group of historical works was exempt from the general rule; and that the narratives contained in the canonical Scriptures are free from any admixture of error. With justice and candour, the lecturer impresses upon his hearers that the special distinction of Christianity, among the religions of the world, lies in its claim to be historical; to be surely founded upon events which have happened, exactly as they are declared to have happened in its sacred books; which are true, that is, in the sense that the statement about the execution of Charles the First is true. Further, it is affirmed that the New Testament presupposes the historical exactness of the Old [207] Testament; that the points of contact of "sacred" and "profane" history are innumerable; and that the demonstration of the falsity of the Hebrew records, especially in regard to those narratives which are assumed to be true in the New Testament, would be fatal to Christian theology.

My utmost ingenuity does not enable me to discover a flaw in the argument thus briefly summarised. I am fairly at a loss to comprehend how any one, for a moment, can doubt that Christian theology must stand or fall with the historical trustworthiness of the Jewish Scriptures. The very conception of the Messiah, or Christ, is inextricably interwoven with Jewish history; the identification of Jesus of Nazareth with that Messiah rests upon the interpretation of passages of the Hebrew Scriptures which have no evidential value unless they possess the historical character assigned to them. If the covenant with Abraham was not made; if circumcision and sacrifices were not ordained by Jahveh; if the "ten words" were not written by God's hand on the stone tables; if Abraham is more or less a mythical hero, such as Theseus; the story of the Deluge a fiction; that of the Fall a legend; and that of the creation the dream of a seer; if all these definite and detailed narratives of apparently real events have no more value as history than have the stories of the regal period [208] of Rome–what is to be said about the Messianic doctrine, which is so much less clearly enunciated? And what about the authority of the writers of the books of the New Testament, who, on this theory, have not merely accepted flimsy fictions for solid truths, but have built the very foundations of Christian dogma upon legendary quicksands?

But these may be said to be merely the carpings of that carnal reason which the profane call common sense; I hasten, therefore, to bring up the forces of unimpeachable ecclesiastical authority in support of my position. In a sermon preached last December, in St. Paul's Cathedral,[2] Canon Liddon declares:–

"For Christians it will be enough to know that our Lord Jesus Christ set the seal of His infallible sanction on the whole of the Old Testament. He found the Hebrew canon as we have it in our hands to-day, and He treated it as an authority which was above discussion. Nay more: He went out of His way–if we may reverently speak thus–to sanction not a few portions of it which modern scepticism rejects. When He would warn His hearers against the dangers of spiritual relapse, He bids them remember "Lot's wife."[3] When He would point out how worldly engagements may blind the soul to a coming judgment, He reminds them how men ate, and drank, and married, and were given in marriage, until the day that Noah entered into [209] the ark, and the Flood came and destroyed them all.[4] [St. Luke xvii.17.] If He would put His finger on a fact in past Jewish history which, by its admitted reality, would warrant belief in His own coming Resurrection, He points to Jonah's being three days and three

nights in the whale's belly (p. 23)."[5]

The preacher proceeds to brush aside the common–I had almost said vulgar–apologetic pretext that Jesus was using *ad hominem* arguments, or "accommodating" his better knowledge to popular ignorance, as well as to point out the inadmissibility of the other alternative, that he shared the popular ignorance. And to those who hold the latter view sarcasm is dealt out with no niggard hand.

"But they will find it difficult to persuade mankind that, if He could be mistaken on a matter of such strictly religious importance as the value of the sacred literature of His countrymen, He can be safely trusted about anything else. The trustworthiness of the Old Testament is, in fact, inseparable from the trustworthiness of our Lord Jesus Christ; and if we believe that He is the true Light of the world, we shall close our ears against suggestions impairing the credit of those Jewish Scriptures which have received the stamp of His Divine authority" (p. 25).

Moreover, I learn from the public journals that a brilliant and sharply-cut view of orthodoxy, of like hue and pattern, was only the other day exhibited in that great theological kaleidoscope, the pulpit of St. Mary's, recalling the time so long passed by, when a Bampton lecturer, in the [210] same place, performed the unusual feat of leaving the faith of old-fashioned Christians undisturbed.

Yet many things have happened in the intervening thirty-one years. The Bampton lecturer of 1859 had to grapple only with the infant Hercules of historical criticism; and he is now a full-grown athlete, bearing on his shoulders the spoils of all the lions that have stood in his path. Surely a martyr's courage, as well as a martyr's faith, is needed by any one who, at this time, is prepared to stand by the following plea for the veracity of the Pentateuch:–

"Adam, according to the Hebrew original, was for 243 years contemporary with Methuselah, who conversed for a hundred years with Shem. Shem was for fifty years contemporary with Jacob, who probably saw Jochebed, Moses's mother. Thus, Moses might by oral tradition have obtained the history of Abraham, and even of the Deluge, at third hand; and that of the Temptation and the Fall at fifth hand.

"If it be granted–as it seems to be–that the great and stirring events in a nation's life will, under ordinary circumstances, be remembered (apart from all written memorials) for the space of 150 years, being handed down through five generations, it must be allowed (even on more human grounds) that the account which Moses gives of the Temptation and the Fall is to be depended upon, if it passed through no more than four hands between him and Adam."[6]

If "the trustworthiness of our Lord Jesus Christ" is to stand or fall with the belief in the sudden transmutation of the chemical components of a woman's body into sodium chloride, or on the [211] "admitted reality" of Jonah's ejection, safe and sound, on the shores of the Levant, after three days' sea-journey in the stomach of a gigantic marine animal, what possible pretext can there be for even hinting a doubt as to the precise truth of the longevity attributed to the Patriarchs? Who that has swallowed the camel of Jonah's journey will be guilty of the affectation of straining at such a historical gnat–nay, midge–as the supposition that the mother of Moses was told the story of the Flood by Jacob; who had it

straight from Shem; who was on friendly terms with Methuselah; who knew Adam quite well?

Yet, by the strange irony of things, the illustrious brother of the divine who propounded this remarkable theory, has been the guide and foremost worker of that band of investigators of the records of Assyria and of Babylonia, who have opened to our view, not merely a new chapter, but a new volume of primeval history, relating to the very people who have the most numerous points of contact with the life of the ancient Hebrews. Now, whatever imperfections may yet obscure the full value of the Mesopotamian records, everything that has been clearly ascertained tends to the conclusion that the assignment of no more than 4000 years to the period between the time of the origin of mankind and that of Augustus Cæsar, is wholly inadmissible. Therefore the Biblical chronology, which Canon [212] Rawlinson trusted so implicitly in 1859, is relegated by all serious critics to the domain of fable.

But if scientific method, operating in the region of history, of philology, of archæology, in the course of the last thirty or forty years, has become thus formidable to the theological dogmatist, what may not be said about scientific method working in the province of physical science? For, if it be true that the Canonical Scriptures have innumerable points of contact with civil history, it is no less true that they have almost as many with natural history; and their accuracy is put to the test as severely by the latter as by the former. The origin of the present state of the heavens and the earth is a problem which lies strictly within the province of physical science; so is that of the origin of man among living things; so is that of the physical changes which the earth has undergone since the origin of man; so is that of the origin of the various races and nations of men, with all their varieties of language and physical conformation. Whether the earth moves round the sun or the contrary; whether the bodily and mental diseases of men and animals are caused by evil spirits or not; whether there is such an agency as witchcraft or not–all these are purely scientific questions; and to all of them the Canonical Scriptures profess to give true answers. And though [213] nothing is more common than the assumption that these books come into conflict only with the speculative part of modern physical science, no assumption can have less foundation.

The antagonism between natural knowledge and the Pentateuch would be as great if the speculations of our time had never been heard of. It arises out of contradiction upon matters of fact. The books of ecclesiastical authority declare that certain events happened in a certain fashion; the books of scientific authority say they did not. As it seems that this unquestionable truth has not yet penetrated among many of those who speak and write on these subjects, it may be useful to give a full illustration of it. And for that purpose I propose to deal, at some length, with the narrative of the Noachian Deluge given in Genesis.

The Bampton lecturer in 1859, and the Canon of St. Paul's in 1890, are in full agreement that this history is true, in the sense in which I have defined historical truth. The former is of opinion that the account attributed to Berosus records a tradition–

"not drawn from the Hebrew record, much less the foundation of that record; yet coinciding with it in the most remarkable way. The Babylonian version is tricked out with a few extravagances, as the monstrous size of the vessel and the translation of Xisuthros; but otherwise it is the Hebrew history *down to its minutiæ*." (p. 64).

[214] Moreover, correcting Niebuhr, the Bampton lecturer points out that the narrative of Berosus implies the universality of the Flood.

"It is plain that the waters are represented as prevailing above the tops of the loftiest mountains in Armenia–a height which must have been seen to involve the submersion of all the countries with which the Babylonians were acquainted" (p. 66).

I may remark, in passing, that many people think the size of Noah's ark "monstrous," considering the probable state of the art of shipbuilding only 1600 years after the origin of man; while others are so unreasonable as to inquire why the translation of Enoch is less an "extravagance" than that of Xisuthros. It is more important, however, to note that the Universality of the Deluge is recognised, not merely as a part of the story, but as a necessary consequence of some of its details. The latest exponent of Anglican orthodoxy, as we have seen, insists upon the accuracy of the Pentateuchal history of the Flood in a still more forcible manner. It is cited as one of those very narratives to which the authority of the Founder of Christianity is pledged, and upon the accuracy of which "the trustworthiness of our Lord Jesus Christ" is staked, just as others have staked it upon the truth of the histories of demoniac possession in the Gospels.

Now, when those who put their trust in scientific methods of ascertaining the truth in the province of natural history find themselves [215] confronted and opposed, on their own ground, by ecclesiastical pretensions to better knowledge, it is, undoubtedly, most desirable for them to make sure that their conclusions, whatever they may be, are well founded. And, if they put aside the unauthorised interference with their business and relegate the Pentateuchal history to the region of pure fiction, they are bound to assure themselves that they do so because the plainest teachings of Nature (apart from all doubtful speculations) are irreconcilable with the assertions which they reject.

At the present time, it is difficult to persuade serious scientific inquirers to occupy themselves, in any way, with the Noachian Deluge. They look at you with a smile and a shrug, and say they have more important matters to attend to than mere antiquarianism. But it was not so in my youth. At that time, geologists and biologists could hardly follow to the end any path of inquiry without finding the way blocked by Noah and his ark, or by the first chapter of Genesis; and it was a serious matter, in this country at any rate, for a man to be suspected of doubting the literal truth of the Diluvial or any other Pentateuchal history. The fiftieth anniversary of the foundation of the Geological Club (in 1824) was, if I remember rightly, the last occasion on which the late Sir Charles Lyell spoke to even so small a public as the members of that body. Our veteran [216] leader lighted up once more; and, referring to the difficulties which beset his early efforts to create a rational science of geology, spoke, with his wonted clearness and vigour, of the social ostracism which pursued him after the publication of the "Principles of Geology," in 1830, on account of the obvious tendency of that noble work to discredit the Pentateuchal accounts of the Creation and the Deluge. If my younger contemporaries find this hard to believe, I may refer them to a grave book, "On the Doctrine of the Deluge," published eight years later, and dedicated by its author to his father, the then Archbishop of York. The first chapter refers to the treatment of the "Mosaic Deluge," by Dr. Buckland and Mr. Lyell, in the following terms:

"Their respect for revealed religion has prevented them from arraying themselves openly against the Scriptural account of it–much less do they deny its truth–but they are in a great hurry to escape from the consideration of it, and evidently concur in the opinion of Linnæus, that no proofs whatever of the Deluge are to be discovered in the structure of the earth." (p. 1).

And after an attempt to reply to some of Lyell's arguments, which it would be cruel to reproduce, the writer continues:–

"When, therefore, upon such slender grounds, it is determined, in answer to those who insist upon its universality, that the Mosaic Deluge must be considered a preternatural event, far beyond the reach of philosophical inquiry; not only as to the causes employed to produce it, but as to the effects most likely [217] to result from it; that determination wears an aspect of scepticism, which, however much soever it may be unintentional in the mind of the writer, yet cannot but produce an evil impression on those who are already predisposed to carp and cavil at the evidences of Revelation" (pp. 8-9).

The kindly and courteous writer of these curious passages is evidently unwilling to make the geologists the victims of general opprobrium by pressing the obvious consequences of their teaching home. One is therefore pained to think of the feelings with which, if he lived so long as to become acquainted with the "Dictionary of the Bible," he must have perused the article "Noah," written by a dignitary of the Church for that standard compendium and published in 1863. For the doctrine of the universality of the Deluge is therein altogether given up; and I permit myself to hope that a long criticism of the story from the point of view of natural science, with which, at the request of the learned theologian who wrote it, I supplied him, may, in some degree, have contributed towards this happy result.

Notwithstanding diligent search, I have been unable to discover that the universality of the Deluge has any defender left, at least among those who have so far mastered the rudiments of natural knowledge as to be able to appreciate the weight of evidence against it. For example, when I turned to the "Speaker's Bible," published under the sanction of high Anglican authority, I [218] found the following judicial and judicious deliverance, the skilful wording of which may adorn, but does not hide, the completeness of the surrender of the old teaching:–

"Without pronouncing too hastily on any fair inferences from the words of Scripture, we may reasonably say that their most natural interpretation is, that the whole race of man had become grievously corrupted since the faithful had intermingled with the ungodly; that the inhabited world was consequently filled with violence, and that God had decreed to destroy all mankind except one single family; that, therefore, all that portion of the earth, perhaps as yet a very small portion, into which mankind had spread was overwhelmed with water. The ark was ordained to save one faithful family; and lest that family, on the subsidence of the waters, should find the whole country round them a desert, a pair of all the beasts of the land and of the fowls of the air were preserved along with them, and along with them went forth to replenish the now desolated continent. The words of Scripture (confirmed as they are by universal tradition) appear at least to mean as much as this. They do not necessarily mean more."[7]

In the third edition of Kitto's "Cyclopædia of Biblical Literature" (1876), the article "Deluge," written by my friend, the present distinguished head of the Geological Survey of Great Britain, extinguishes the

universality doctrine as thoroughly as might be expected from its authorship; and, since the writer of the article "Noah" refers his readers to that entitled "Deluge," it is to be supposed, notwithstanding his generally orthodox tone, that he does not dissent from its conclusions. Again, the writers in Herzog's "Real-Encyclopädia" [219] (Bd. X. 1882) and in Riehm's "Handwörterbuch" (1884)–both works with a conservative leaning–are on the same side; and Diestel,[8] in his full discussion of the subject, remorselessly rejects the universality doctrine. Even that staunch opponent of scientific rationalism–may I say rationality?–Zöckler[9] flinches from a distinct defence of the thesis, any opposition to which, well within my recollection, was howled down by the orthodox as mere "infidelity." All that, in his sore straits, Dr. Zöckler is able to do, is to pronounce a faint commendation upon a particularly absurd attempt at reconciliation, which would make out the Noachian Deluge to be a catastrophe which occurred at the end of the Glacial Epoch. This hypothesis involves only the trifle of a physical revolution of which geology knows nothing; and which, if it secured the accuracy of the Pentateuchal writer about the fact of the Deluge, would leave the details of his account as irreconcilable with the truths of elementary physical science as ever. Thus I may be permitted to spare myself and my readers the weariness of a recapitulation of the overwhelming arguments against the universality of the Deluge, which they will now find for themselves stated, as fully and forcibly as could be wished, by Anglican and other theologians, whose orthodoxy and conservative tend[220]encies have, hitherto, been above suspicion. Yet many fully admit (and, indeed, nothing can be plainer) that, as a matter of fact, the whole earth known to him was inundated; nor is it less obvious that unless all mankind, with the exception of Noah and his family, were actually destroyed, the references to the Flood in the New Testament are unintelligible.

But I am quite aware that the strength of the demonstration that no universal Deluge ever took place has produced a change of front in the army of apologetic writers. They have imagined that the substitution of the adjective "partial" for "universal," will save the credit of the Pentateuch, and permit them, after all, without too many blushes, to declare that the progress of modern science only strengthens the authority of Moses. Nowhere have I found the case of the advocates of this method of escaping from the difficulties of the actual position better put than in the lecture of Professor Diestel to which I have referred. After frankly admitting that the old doctrine of universality involves physical impossibilities, he continues:–

"All these difficulties fall away as soon as we give up the universality of the Deluge, and imagine a *partial* flooding of the earth, say in western Asia. But have we a right to do so? The narrative speaks of "the whole earth." But what is the meaning of this expression? Surely not the whole surface of [221] the earth according to the ideas of *modern* geographers, but, at most, according to the conceptions of the Biblical author. This very simple conclusion, however, is never drawn by too many readers of the Bible. But one need only cast one's eyes over the tenth chapter of Genesis in order to become acquainted with the geographical horizon of the Jews. In the north it was bounded by the Black Sea and the mountains of Armenia; extended towards the east very little beyond the Tigris; hardly reached the apex of the Persian Gulf; passed, then, through the middle of Arabia and the Red Sea; went southward through Abyssinia, and then turned westward by the frontiers of Egypt, and inclosed the easternmost islands of the Mediterranean" (p. 11).

The justice of this observation must be admitted, no less than the further remark that, in still earlier

times, the pastoral Hebrews very probably had yet more restricted notions of what constituted the "whole earth." Moreover, I, for one, fully agree with Professor Diestel that the motive, or generative incident, of the whole story is to be sought in the occasionally excessive and desolating floods of the Euphrates and the Tigris.

Let us, provisionally, accept the theory of a partial deluge, and try to form a clear mental picture of the occurrence. Let us suppose that, for forty days and forty nights, such a vast quantity of water was poured upon the ground that the whole surface of Mesopotamia was covered by water to a depth certainly greater, probably much greater, than fifteen cubits, or twenty feet (Gen. vii. 20). The inundation prevails upon the earth for one hundred and fifty days and then the flood gradually decreases, until, on the seven [222]teenth day of the seventh month, the ark, which had previously floated on its surface, grounds upon the "mountains of Ararat"[10] (Gen. viii. 34). Then, as Diestel has acutely pointed out ("Sintflut," p. 13), we are to imagine the further subsidence of the flood to take place so gradually that it was not until nearly two months and a half after this time (that is to say, on the first day of the tenth month) that the "tops of the mountains" became visible. Hence it follows that, if the ark drew even as much as twenty feet of water, the level of the inundation fell very slowly–at a rate of only a few inches a day–until the top of the mountain on which it rested became visible. This is an amount of movement which, if it took place in the sea, would be overlooked by ordinary people on the shore. But the Mesopotamian plain slopes gently, from an elevation of 500 or 600 feet at its northern end, to the sea, at its southern end, with hardly so much as a notable ridge to break its uniform flatness, for 300 to 400 miles. These being the conditions of the case, the following inquiry naturally presents itself: not, be it observed, as a recondite problem, generated by modern speculation, but as a plain suggestion flowing out of that very ordinary and archaic piece of knowledge that water cannot be [223] piled up like in a heap, like sand; or that it seeks the lowest level. When, after 150 days, "the fountains also of the deep and the windows of heaven were stopped, and the rain from heaven was restrained" (Gen. viii.2), what prevented the mass of water, several, possibly very many, fathoms deep, which covered, say, the present site of Bagdad, from sweeping seaward in a furious torrent; and, in a very few hours, leaving, not only the "tops of the mountains," but the whole plain, save any minor depressions, bare? How could its subsistence, by any possibility, be an affair of weeks and months?

And if this difficulty is not enough, let any one try to imagine how a mass of water several perhaps very many, fathoms deep, could be accumulated on a flat surface of land rising well above the sea, and separated from it by no sort of barrier. Most people know Lord's Cricket-ground. Would it not be an absurd contradiction to our common knowledge of the properties of water to imagine that, if all the mains of all the waterworks of London were turned on to it, they could maintain a heap of water twenty feet deep over its level surface? Is it not obvious that the water, whatever momentary accumulation might take place at first, would not stop there, but that it would dash, like a mighty mill-race, southwards down the gentle slope which ends in the Thames? And is it not further obvious, that whatever [224] depth of water might be maintained over the cricket-ground so long as all the mains poured on to it, anything which floated there would be speedily whirled away by the current, like a cork in a gutter when the rain pours? But if this is so, then it is no less certain that Noah's deeply laden, sailless, oarless, and rudderless craft, if by good fortune it escaped capsizing in whirlpools, or having its bottom knocked into holes by snags (like those which prove fatal even to well-built steamers on the Mississippi in our day),

would have speedily found itself a good way down the Persian Gulf, and not long after in the Indian Ocean, somewhere between Arabia and Hindostan. Even if, eventually, the ark might have gone ashore, with other jetsam and flotsam, on the coasts of Arabia, or of Hindostan, or of the Maldives, or of Madagascar, its return to the "mountains of Ararat" would have been a miracle more stupendous than all the rest.

Thus, the last state of the would-be reconcilers of the story of the Deluge with fact is worse than the first. All that they have done is to transfer the contradictions to established truth from the region of science proper to that of common information and common sense. For, really, the assertion that the surface of a body of deep water, to which no addition was made, and which there was nothing to stop from running into the sea, sank at the rate of only a few inches or even feet [225] a day, simply outrages the most ordinary and familiar teachings of every man's daily experience. A child may see the folly of it.

In addition, I may remark that the necessary assumption of the "partial Deluge" hypothesis (if it is confined to Mesopotamia) that the Hebrew writer must have meant low hills when he said "high mountains," is quite untenable. On the eastern side of the Mesopotamian plain, the snowy peaks of the frontier ranges of Persia are visible from Bagdad,[11] and even the most ignorant herdsmen in the neighbourhood of "Ur of the Chaldees," near its western limit, could hardly have been unacquainted with the comparatively elevated plateau of the Syrian desert which lay close at hand. But, surely, we must suppose the Biblical writer to be acquainted with the highlands of Palestine and with the masses of the Sinaitic peninsula, which soar more than 8000 feet above the sea, if he knew of no higher elevations; and, if so, he could not well have meant to refer to mere hillocks when he said that "all the high mountains which were under the whole heaven were covered" (Genesis vii. 19). Even the hill-country of Galilee reaches an elevation of 4000 feet; and a flood which covered it could by no possibility have been other than universal in its superficial extent. Water really cannot be got to stand at, [226] say, 4000 feet above the sea-level over Palestine, without covering the rest of the globe to the same height. Even if, in the course of Noah's six hundredth year, some prodigious convulsion had sunk the whole region inclosed within "the horizon of the geographical knowledge" of the Israelites by that much, and another had pushed it up again, just in time to catch the ark upon the "mountains of Ararat," matters are not much mended. I am afraid to think of what would have become of a vessel so little seaworthy as the ark and of its very numerous passengers, under the peculiar obstacles to quiet flotation which such rapid movements of depression and upheaval would have generated.

Thus, in view, not, I repeat of the recondite speculations of infidel philosophers, but in the face of the plainest and most commonplace of ascertained physical facts, the story of the Noachian Deluge has no more claim to credit than has that of Deucalion; and whether it was, or was not, suggested by the familiar acquaintance of its originators with the effects of unusually great overflows of the Tigris and Euphrates, it is utterly devoid of historical truth.

That is, in my judgment, the necessary result of the application of criticism, based upon assured physical knowledge to the story of the Deluge. And it is satisfactory that the criticism which is [227] based, not upon literary and historical speculations, but upon well-ascertained facts in the departments of literature

and history, tends to exactly the same conclusion.

For I find this much agreed upon by all Biblical scholars of repute, that the story of the Deluge in Genesis is separable into at least two sets of statements; and that, when the statements thus separated are recombined in their proper order, each set furnishes an account of the event, coherent and complete within itself, but in some respects discordant with that afforded by the other set. This fact, as I understand, is not disputed. Whether one of these is the work of an Elohist, and the other of a Jehovist narrator; whether the two have been pieced together in this strange fashion because, in the estimation of the compilers and editors of the Pentateuch, they had equal and independent authority, or not; or whether there is some other way of accounting for it–are questions the answers to which do not affect the fact. If possible I avoid *a priori* arguments. But still, I think it may be urged, without imprudence, that a narrative having this structure is hardly such as might be expected from a writer possessed of full and infallibly accurate knowledge. Once more, it would seem that it is not necessarily the mere inclination of the sceptical spirit to question everything, or the wilful blindness of infidels, which prompts grave doubts as to the [228] value of a narrative thus curiously unlike the ordinary run of veracious histories.

But the voice of archæological and historical criticism still has to be heard; and it gives forth no uncertain sound. The marvellous recovery of the records of an antiquity, far superior to any that can be ascribed to the Pentateuch, which has been effected by the decipherers of cuneiform characters, has put us in possession of a series, once more, not of speculations, but of facts, which have a most remarkable bearing upon the question of the truthworthiness of the narrative of the Flood. It is established, that for centuries before the asserted migration of Terah from Ur of the Chaldees (which, according to the orthodox interpreters of the Pentateuch, took place after the year 2000 B.C.) Lower Mesopotamia was the seat of a civilisation in which art and science and literature had attained a development formerly unsuspected or, if there were faint reports of it, treated as fabulous. And it is also no matter of speculation, but a fact, that the libraries of these people contain versions of a long epic poem, one of the twelve books of which tells a story of a deluge, which, in a number of its leading features, corresponds with the story attributed to Berosus, no less than with the story given in Genesis, with curious exactness. Thus,the correctness of Canon Rawlinson's conclusion, cited above, that the story of Berosus was neither drawn from the Hebrew [229] record, nor is the foundation of it, can hardly be questioned. It is highly probable, if not certain, that Berosus relied upon one of the versions (for there seem to have been several) of the old Babylonian epos, extant in his time; and, if that is a reasonable conclusion, why is it unreasonable to believe that the two stories, which the Hebrew compiler has put together in such an inartistic fashion, were ultimately derived from the same source? I say ultimately, because it does not at all follow that the two versions, possibly trimmed by the Jehovistic writer on the one hand, and by the Elohistic on the other, to suit Hebrew requirements, may not have been current among the Israelites for ages. And they may have acquired great authority before they were combined in the Pentateuch.

Looking at the convergence of all these lines of evidence to the one conclusion–that the story of the Flood in Genesis is merely a Bowdlerised version of one of the oldest pieces of purely fictitious literature extant; that whether this is, or is not, its origin, the events asserted in it to have taken place assuredly never did take place; further, that, in point of fact, the story, in the plain and logically necessary sense of its words, has long since been given up by orthodox and conservative commentators

of the Established Church–I can but admire the courage and clear foresight of the Anglican divine who tells us that [230] we must be prepared to choose between the trustworthiness of scientific method and the trustworthiness of that which the Church declares to be Divine authority. For, to my mind, this declaration of war to the knife against secular science, even in its most elementary form; this rejection, without a moment's hesitation, of any and all evidence which conflicts with theological dogma–is the only position which is logically reconcilable with the axioms of orthodoxy. If the Gospels truly report that which an incarnation of the God of Truth communicated to the world, then it surely is absurd to attend to any other evidence touching matters about which he made any clear statement, or the truth of which is distinctly implied by his words. If the exact historical truth of the Gospels is an axiom of Christianity, it is as just and right for a Christian to say, Let us "close our ears against suggestions" of scientific critics, as it is for the man of science to refuse to waste his time upon circle-squarers and flat-earth fanatics.

It is commonly reported that the manifesto by which the Canon of St. Paul's proclaims that he nails the colours of the straitest Biblical infallibility to the mast of the ship ecclesiastical, was put forth as a counterblast to "Lux Mundi"; and that the passages which I have more particularly quoted are directed against the essay on "The Holy Spirit and Inspiration" in that [231] collection of treatises by Anglican divines of high standing, who must assuredly be acquitted of conscious "infidel" proclivities. I fancy that rumour must, for once, be right, for it is impossible to imagine a more direct and diametrical contradiction than that between the passages from the sermon cited above and those which follow:–

"What is questioned is that our Lord's words foreclose certain critical positions as to the character of Old Testament literature. For example, does His use of Jonah's resurrection as a *type* of His own, depend in any real degree upon whether it is historical fact or allegory? . . . Once more, our Lord uses the time before the Flood, to illustrate the carelessness of men before His own coming. . . . In referring to the Flood He certainly suggests that He is treating it as typical, for He introduces circumstances–"eating and drinking, marrying and giving in marriage "–which have no counterpart in the original narrative" (pp. 358-9).

While insisting on the flow of inspiration through the whole of the Old Testament, the essayist does not admit its universality. Here, also, the new apologetic demands a partial flood:

"But does the inspiration of the recorder guarantee the exact historical truth of what he records? And, in matter of fact, can the record with due regard to legitimate historical criticism, be pronounced true? Now, to the latter of these two questions (and they are quite distinct questions) we may reply that there is nothing to prevent our believing, as our faith strongly disposes us to believe, that the record from Abraham downward is, in substance, in the strict sense historical" (p. 351).

It would appear, therefore, that there is nothing to prevent our believing that the record, from [232] Abraham upward, consists of stories in the strict sense unhistorical, and that the pre-Abrahamic narratives are mere moral and religious "types" and parables.

I confess I soon lose my way when I try to follow those who walk delicately among "types" and allegories. A certain passion for clearness forces me to ask, bluntly, whether the writer means to say that

Jesus did not believe the stories in question, or that he did? When Jesus spoke, as of a matter of fact, that "the Flood came and destroyed them all," did he believe that the Deluge really took place, or not? It seems to me that, as the narrative mentions Noah's wife, and his sons' wives, there is good scriptural warranty for the statement that the antediluvians married and were given in marriage; and I should have thought that their eating and drinking might be assumed by the firmest believer in the literal truth of the story. Moreover, I venture to ask what sort of value, as an illustration of God's methods of dealing with sin, has an account of an event that never happened? If no Flood swept the careless people away, how is the warning of more worth than the cry of "Wolf" when there is no wolf? If Jonah's three days' residence in the whale is not an "admitted reality," how could it "warrant belief" in the "coming resurrection?" If Lot's wife was not turned into a pillar of salt, the bidding [233] those who turn back from the narrow path to "remember" it is, morally, about on a level with telling a naughty child that a bogy is coming to fetch it away. Suppose that a Conservative orator warns his hearers to beware of great political and social changes, lest they end, as in France, in the domination of a Robespierre; what becomes, not only of his argument, but of his veracity, if he, personally, does not believe that Robespierre existed and did the deeds attributed to him?

Like all other attempts to reconcile the results of scientifically-conducted investigation with the demands of the outworn creeds of ecclesiasticism, the essay on Inspiration is just such a failure as must await mediation, when the mediator is unable properly to appreciate the weight of the evidence for the case of one of the two parties. The question of "Inspiration" really possesses no interest for those who have cast ecclesiasticism and all its works aside, and have no faith in any source of truth save that which is reached by the patient application of scientific methods. Theories of inspiration are speculations as to the means by which the authors of statements, in the Bible or elsewhere, have been led to say what they have said–and it assumes that natural agencies are insufficient for the purpose. I prefer to stop short of this problem, finding it more profitable to undertake the inquiry which [234] naturally precedes it–namely, Are these statements true or false? If they are true, it may be worth while to go into the question of their supernatural generation; if they are false, it certainly is not worth mine.

Now, not only do I hold it to be proven that the story of the Deluge is a pure fiction; but I have no hesitation in affirming the same thing of the story of the Creation.[12] Between these two lies the story of the creation of man and woman and their fall from primitive innocence, which is even more monstrously improbable than either of the other two, though, from the nature of the case, it is not so easily capable of direct refutation. It can be demonstrated that the earth took longer than six days in the making, and that the Deluge, as described, is a physical impossibility; but there is no proving, especially to those who are perfect in the art of closing their ears to that which they do not wish to hear, that a snake did not speak, or that Eve was not made out of one of Adam's ribs.

[235] The compiler of Genesis, in its present form, evidently had a definite plan in his mind. His countrymen, like all other men, were doubtless curious to know how the world began; how men, and especially wicked men, came into being, and how existing nations and races arose among the descendants of one stock; and, finally, what was the history of their own particular tribe. They, like ourselves, desired to solve the four great problems of cosmogeny, anthropogeny, ethnogeny, and

geneogeny. The Pentateuch furnishes the solutions which appeared satisfactory to its author. One of these, as we have seen, was borrowed from a Babylonian fable; and I know of no reason to suspect any different origin for the rest. Now, I would ask, is the story of the fabrication of Eve to be regarded as one of those pre-Abrahamic narratives, the historical truth of which is an open question, in face of the reference to it in a speech unhappily famous for the legal oppression to which it has been wrongfully forced to lend itself?

"Have ye not read, that he which made them from the beginning made them male and female, and said, For this cause shall a man leave his father and mother, and cleave to his wife; and the twain shall become one flesh?" (Matt. xix.5.)

If divine authority is not here claimed for the twenty-fourth verse of the second chapter of [236] Genesis, what is the value of language? And again, I ask, if one may play fast and loose with the story of the Fall as a "type" or "allegory," what becomes of the foundation of Pauline theology?–

"For since by man came death, by man came also the resurrection of the dead. For as in Adam all die, so also in Christ shall all be made alive" (1 Corinthians xv. 21, 22).

If Adam may be held to be no more real a personage than Prometheus, and if the story of the Fall is merely an instructive "type," comparable to the profound Promethean mythus, what value has Paul's dialectic?

While, therefore, every right-minded man must sympathise with the efforts of those theologians, who have not been able altogether to close their ears to the still, small, voice of reason, to escape from the fetters which ecclesiasticism has forged; the melancholy fact remains, that the position they have taken up is hopelessly untenable. It is raked alike by the old-fashioned artillery of the churches and by the fatal weapons of precision with which the *enfants perdus* of the advancing forces of science are armed. They must surrender, or fall back into a more sheltered position. And it is possible that they may long find safety in such retreat.

It is, indeed, probable that the proportional number of those who will distinctly profess their [237] belief in the transubstantiation of Lot's wife, and the anticipatory experience of submarine navigation by Jonah; in water standing fathoms deep on the side of a declivity without anything to hold it up; and in devils who enter swine–will not increase. But neither is there ground for much hope that the proportion of those who cast aside these fictions and adopt the consequence of that repudiation, are, for some generations, likely to constitute a majority. Our age is a day of compromises. The present and the near future seem given over to those happily, if curiously, constituted people who see as little difficulty in throwing aside any amount of post-Abrahamic Scriptural narrative, as the authors of "Lux Mundi" see in sacrificing the pre-Abrahamic stories; and, having distilled away every inconvenient matter of fact in Christian history, continue to pay divine honours to the residue. There really seems to be no reason why the next generation should not listen to a Bampton Lecture modelled upon that addressed to the last:–

"Time was–and that not very long ago–when all the relations of Biblical authors concerning the whole world

were received with a ready belief; and an unreasoning and uncritical faith accepted with equal satisfaction the narrative of the Captivity and the doings of Moses at the court of Pharaoh, the account of the Apostolic meeting in the Epistle to the Galatians, and that of the fabrication of Eve. We can most of us remember when, in this country, the whole story of the Exodus, and even the legend of Jonah, were seriously placed before boys [238] as history; and discoursed of in as dogmatic a tone as the tale of Agincourt or the history of the Norman Conquest.

But all this is now changed. The last century has seen the growth of scientific criticism to its full strength. The whole world of history has been revolutionised and the mythology which embarrassed earnest Christians has vanished as an evil mist, the lifting of which has only more fully revealed the lineaments of infallible Truth. No longer in contact with fact of any kind, Faith stands now and for ever proudly inaccessible to the attacks of the infidel."

So far the apologist of the future. Why not? *Cantabit vacuus.*

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[1] *Bampton Lectures* (1859), on "The Historical Evidence of the Truth of the Scripture Records stated anew, with Special Reference to the Doubts and Discoveries of Modern Times," by the Rev. G. Rawlinson, M.A., pp. 5-6.

[2] *The Worth of the Old Testament,* a Sermon preached in St. Paul's Cathedral on the second Sunday in Advent, 8th Dec., 1889, by H. P. Liddon, D.D., C. L., Canon and Chancellor of St. Paul's. Second edition revised and with a new preface, 1890.

[3] St. Luke xvii. 32.

[4] St. Luke xvii. 27.

[5] St. Matt. xii. 40.

[6] *Bampton Lectures,* 1859, pp. 50-51.

[7] *Commentary on Genesis,* by the Bishop of Ely, p. 77.

[8] *Die Sintflut,* 1876.

[9] *Theologie und Naturwissenschaft,* ii. 784-791 (1877).

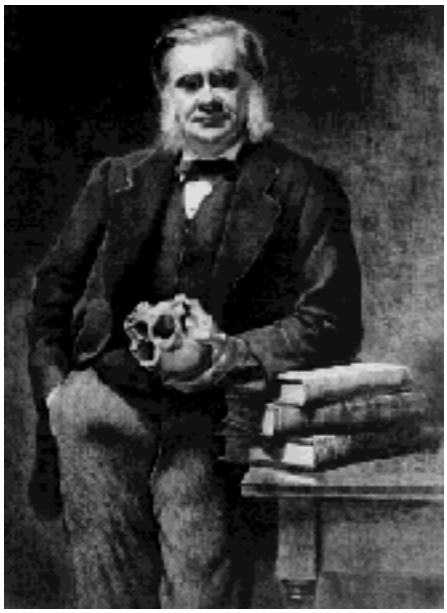
[10] It is very doubtful if this means the region of the Armenian Ararat. More probably it designates some part either of the Kurdish range or of its south-eastern continuation.

[11] So Reclus (*Nouvelle Géographie Universelle,* ix. 386), but I find the statement doubted by an authority of the first rank.

[12] So far as I know, the narrative of the Creation is not now held to be true, in the sense in which I have defined historical truth, by any of the reconcilers. As for the attempts to stretch the Pentateuchal days into periods of thousands or millions of years, the verdict of the eminent Biblical scholar, Dr. Riehm (*Der biblische Schöpfungsbericht*, 1881, pp. 15, 16) on such pranks of "Auslegungskunst" should be final. Why do the reconcilers take Goethe's advice seriously?–

"Im Auslegen seyd frisch und munter!

Legt ihr's nicht aus, so legt was unter."



Hasisadra's Adventure (1891)

Collected Essays IV

[239] Some thousands of years ago there was a city in Mesopotamia called Surippak. One night a strange dream came to a dweller therein, whose name, if rightly reported, was Hasisadra. The dream foretold the speedy coming of a great flood; and it warned Hasisadra to lose no time in building a ship, in which, when notice was given, he, his family and friends, with their domestic animals and a collection of wild creatures and seed of plants of the land, might take refuge and be rescued from destruction. Hasisadra awoke, and at once acted upon the warning. A strong decked ship was built, and her sides were paid, inside and out, with the mineral pitch, or bitumen, with which the country abounded; the vessel's seaworthiness was tested, the cargo was stowed away, and a trusty pilot or steersman appointed.

[240] The promised signal arrived. Wife and friends embarked; Hasisadra, following, prudently "shut the door," or, as we should say, put on the hatches; and Nes-Hea, the pilot, was left alone on deck to do his best for the ship. Thereupon a hurricane began to rage; rain fell in torrents; the subterranean waters burst forth; a deluge swept over the land, and the wind lashed it into waves sky high; heaven and earth became mingled in chaotic gloom. For six days and seven nights the gale raged, but the good ship held out until, on the seventh day, the storm lulled. Hasisadra ventured on deck; and, seeing nothing but a waste of waters strewed with floating corpses and wreck, wept over the destruction of his land and people. Far away, the mountains of Nizir were visible; the ship was steered for them and ran aground upon the higher land. Yet another seven days passed by. On the seventh, Hasisadra sent forth a dove, which found no resting place and returned; then he liberated a swallow, which also came back; finally, a raven was let loose, and that sagacious bird, when it found that the water had abated, came near the ship, but refused to return to it. Upon this, Hasisadra liberated the rest of the wild animals, which immediately dispersed in all directions, while he, with his family and friends, ascending a mountain hard by, offered sacrifice upon its summit to the gods.

[241] The story thus given in summary abstract, told in an ancient Semitic dialect, is inscribed in cuneiform characters upon a tablet of burnt clay. Many thousands of such tablets, collected by Assurbanipal, King of Assyria in the middle of the seventh century B.C., were stored in the library of his palace at Nineveh; and, though in a sadly broken and mutilated condition, they have yielded a marvellous amount of information to the patient and sagacious labour which modern scholars have bestowed upon them. Among the multitude of documents of various kinds, this narrative of Hasisadra's adventure has been found in a tolerably complete state. But Assyriologists agree that it is only a copy of a much more ancient work; and there are weighty reasons for believing that the story of Hasisadra's flood was well known in Mesopotamia before the year 2000 B.C.

No doubt, then, we are in presence of a narrative which has all the authority which antiquity can confer; and it is proper to deal respectfully with it, even though it is quite as proper, and indeed necessary, to act no less respectfully towards ourselves; and, before professing to put implicit faith in it, to inquire what

claim it has to be regarded as a serious account of an historical event.

It is of no use to appeal to contemporary history, although the annals of Babylonia, no less [242] than those of Egypt, go much further back than 2000 B.C. All that can be said is, that the former are hardly consistent with the supposition that any catastrophe, competent to destroy all the population, has befallen the land since civilisation began, and that the latter are notoriously silent about deluges. In such a case as this, however, the silence of history does not leave the inquirer wholly at fault. Natural science has something to say when the phenomena of nature are in question. Natural science may be able to show, from the nature of the country, either that such an event as that described in the story is impossible, or at any rate highly improbable; or, on the other hand, that it is consonant with probability. In the former case, the narrative must be suspected or rejected; in the latter, no such summary verdict can be given: on the contrary, it must be admitted that the story may be true. And then, if certain strangely prevalent canons of criticism are accepted, and if the evidence that an event might have happened is to be accepted as proof that it did happen, Assyriologists will be at liberty to congratulate one another on the "confirmation by modern science" of the authority of their ancient books.

It will be interesting, therefore, to inquire how far the physical structure and the other conditions of the region in which Surippak was situated are [243] compatible with such a flood as is described in the Assyrian record.

The scene of Hasisadra's adventure is laid in the broad valley, six or seven hundred miles long, and hardly anywhere less than a hundred miles in width, which is traversed by the lower courses of the rivers Euphrates and Tigris, and which is commonly known as the "Euphrates valley." Rising, at the one end, into a hill country, which gradually passes into the Alpine heights of Armenia; and, at the other, dipping beneath the shallow waters of the head of the Persian Gulf, which continues in the same direction, from north-west to south-east, for some eight hundred miles farther, the floor of the valley presents a gradual slope, from eight hundred feet above the sea level to the depths of the southern end of the Persian Gulf. The boundary between sea and land, formed by the extremest mudflats of the delta of the two rivers, is but vaguely defined; and, year by year, it advances seaward. On the north-eastern side, the western frontier ranges of Persia rise abruptly to great heights; on the south-western side, a more gradual ascent leads to a table-land of less elevation, which, very broad in the south, where it is occupied by the deserts of Arabia and of Southern Syria, narrows, northwards, into the highlands of Palestine, and is continued by the ranges of the Lebanon, the Antilebanon, and the Taurus, into the highlands of Armenia.

[244] The wide and gently inclined plain, thus inclosed between the gulf and the highlands, on each side and at its upper extremity, is distinguishable into two regions of very different character, one of which lies north, and the other south of the parallel of Hit, on the Euphrates. Except in the immediate vicinity of the river, the northern division is stony and scantily covered with vegetation, except in spring. Over the southern division, on the contrary, spreads a deep alluvial soil, in which even a pebble is rare; and which, though, under the existing misrule, mainly a waste of marsh and wilderness, needs only intelligent attention to become, as it was of old, the granary of western Asia. Except in the extreme south, the rainfall is small and the air dry. The heat in summer is intense, while bitterly cold northern blasts sweep the plain in winter. Whirlwinds are not uncommon; and, in the intervals of the periodical

inundations, the fine, dry, powdery soil is swept, even by moderate breezes, into stifling clouds, or rather fogs, of dust. Low inequalities, elevations here and depressions there, diversify the surface of the alluvial region. The latter are occupied by enormous marshes, while the former support the permanent dwellings of the present scanty and miserable population.

In antiquity, so long as the canalisation of the country was properly carried out, the fertility of the alluvial plain enabled great and prosperous nations to have their home in the Euphrates [245] valley. Its abundant clay furnished the materials for the masses of sun-dried and burnt bricks, the remains of which, in the shape of huge artificial mounds, still testify to both the magnitude and the industry of the population, thousands of years ago. Good cement is plentiful, while the bitumen, which wells from the rocks at Hit and elsewhere, not only answers the same purpose, but is used to this day, as it was in Hasisadra's time, to pay the inside and the outside of boats.

In the broad lower course of the Euphrates, the stream rarely acquires a velocity of more than three miles an hour, while the lower Tigris attains double that rate in times of flood. The water of both great rivers is mainly derived from the northern and eastern highlands in Armenia and in Kurdistan, and stands at its lowest level in early autumn and in January. But when the snows accumulated in the upper basins of the great rivers, during the winter, melt under the hot sunshine of spring, they rapidly rise,[1] and at length overflow their banks, covering the alluvial plain with a vast inland sea, interrupted only by the higher ridges and hummocks which form islands in a seemingly boundless expanse of water.

In the occurrence of these annual inundations [246] lies one of several resemblances between the valley of the Euphrates and that of the Nile. But there are important differences. The time of the annual flood is reversed, the Nile being highest in autumn and winter, and lowest in spring and early summer. The periodical overflows of the Nile, regulated by the great lake basins in the south, are usually punctual in arrival, gradual in growth, and beneficial in operation. No lakes are interposed between the mountain torrents of the upper basis of the Tigris and the Euphrates and their lower courses. Hence, heavy rain, or an unusually rapid thaw in the uplands, gives rise to the sudden irruption of a vast volume of water which not even the rapid Tigris, still less its more sluggish companion, can carry off in time to prevent violent and dangerous overflows. Without an elaborate system of canalisation, providing an escape for such sudden excesses of the supply of water, the annual floods of the Euphrates, and especially of the Tigris, must always be attended with risk, and often prove harmful.

There are other peculiarities of the Euphrates valley which may occasionally tend to exacerbate the evils attendant on the inundations. It is very subject to seismic disturbances; and the ordinary consequences of a sharp earthquake shock might be seriously complicated by its effect on a broad sheet of water. Moreover the Indian Ocean lies within the region of typhoons; and if, at the height [247] of an inundation, a hurricane from the south-east swept up the Persian Gulf, driving its shallow waters upon the delta and damming back the outflow, perhaps for hundreds of miles up-stream, a diluvial catastrophe, fairly up to the mark of Hasisadra's, might easily result.[2]

Thus there seems to be no valid reason for rejecting Hasisadra's story on physical grounds. I do not

gather from the narrative that the "mountains of Nizir" were supposed to be submerged, but merely that they came into view above the distant horizon of the waters, as the vessel drove in that direction. Certainly the ship is not supposed to ground on any of their higher summits, for Hasisadra has to ascend a peak in order to offer his sacrifice. The country of Nizir lay on the north-eastern side of the Euphrates valley, about the courses of the two rivers Zab, which enter the Tigris where it traverses the plain of Assyria some eight or nine hundred feet above the sea; and, so far as I can judge from maps[3] and other sources of information, it is possible, under the circumstances supposed, that such a ship as Hasisadra's might drive before a [248] southerly gale, over a continuously flooded country, until it grounded on some of the low hills between which both the lower and the upper Zab enter upon the Assyrian plain.

The tablet which contains the story under consideration is the eleventh of a series of twelve. Each of these answers to a month, and to the corresponding sign of the Zodiac. The Assyrian year began with the spring equinox; consequently, the eleventh month, called "the rainy," answers to our January-February, and to the sign which corresponds with our Aquarius. The aquatic adventure of Hasisadra, therefore, is not inappropriately placed. It is curious, however, that the season thus indirectly assigned to the flood is not that of the present highest level of the rivers. It is too late for the winter rise and too early for the spring floods.

I think it must be admitted that, so far, the physical cross-examination to which Hasisadra has been subjected does not break down his story. On the contrary, he proves to have kept it in all essential respects[4] within the bounds of probability or possibility. However, we have not yet done with him. For the conditions which obtained in the Euphrates valley, four or five thousand years [249] ago, may have differed to such an extent from those which now exist that we should be able to convict him of having made up his tale. But here again everything is in favour of his credibility. Indeed, he may claim very powerful support, for it does not lie in the mouths of those who accept the authority of the Pentateuch to deny that the Euphrates valley was what it is, even six thousand years back. According to the book of Genesis, Phrat and Hiddekel–the Euphrates and the Tigris–are coeval with Paradise. An edition of the Scriptures, recently published under high authority, with an elaborate apparatus of "Helps" for the use of students–and therefore, as I am bound to suppose, purged of all statements that could by any possibility mislead the young–assigns the year B.C. 4004 as the date of Adam's too brief residence in that locality.

But I am far from depending on this authority for the age of the Mesopotamian plain. On the contrary, I venture to rely, with much more confidence, on another kind of evidence, which tends to show that the age of the great rivers must be carried back to a date earlier than that at which our ingenuous youth is instructed that the earth came into existence. For, the alluvial deposit having been brought down by the rivers, they must needs be older than the plain it forms, as navvies must needs antecede the embankment painfully built up by the contents of their wheel-[250]barrows. For thousands of years, heat and cold, rain, snow, and frost, the scrubbing of glaciers, and the scouring of torrents laden with sand and gravel, have been wearing down the rocks of the upper basins of the rivers, over an area of many thousand square miles; and these materials, ground to fine powder in the course of their long journey, have slowly subsided, as the water which carried them spread out and lost its velocity in the sea. It is because this process is still going on that the shore of the delta constantly encroaches on the head of the gulf[5] into

which the two rivers are constantly throwing the waste of Armenia and of Kurdistan. Hence, as might be expected, fluviatile and marine shells are common in the alluvial deposit; and Loftus found strata, containing subfossil marine shells of species now living, in the Persian Gulf, at Warka, two hundred miles in a straight line from the shore of the delta.[6] It follows that, if a trustworthy estimate of the average rate of growth of the alluvial can be formed, the lowest limit (by no means the highest limit) of age of the rivers can be determined. All such estimates are beset with sources [251] of error of very various kinds; and the best of them can only be regarded as approximations to the truth. But I think it will be quite safe to assume a maximum rate of growth of four miles in a century for the lower half of the alluvial plain.

Now, the cycle of narratives of which Hasisadra's adventure forms a part contains allusions not only to Surippak, the exact position of which is doubtful, but to other cities, such as Erech. The vast ruins at the present village of Warka have been carefully explored and determined to be all that remains of that once great and flourishing city, "Erech the lofty." Supposing that the two hundred miles of alluvial country, which separates them from the head of the Persian Gulf at present, have been deposited at the very high rate of four miles in a century, it will follow that 4000 years ago, or about the year 2100 B.C., the city of Erech still lay forty miles inland. Indeed, the city might have been built a thousand years earlier. Moreover, there is plenty of independent archæological and other evidence that in the whole thousand years, 2000 to 3000 B.C, the alluvial plain was inhabited by a numerous people, among whom industry, art, and literature had attained a very considerable development. And it can be shown that the physical conditions and the climate of the Euphrates valley, at that time, must have been extremely similar to what they are now.

[252] Thus, once more, we reach the conclusion that, as a question of physical probability, there is no ground for objecting to the reality of Hasisadra's adventure. It would be unreasonable to doubt that such a flood might have happened, and that such a person might have escaped in the way described, any time during the last 5000 years. And if the postulate of loose thinkers in search of scientific "confirmations" of questionable narratives–proof that an event may have happened is evidence that it did happen–is to be accepted, surely Hasisadra's story is "confirmed by modern scientific investigation" beyond all cavil. However, it may be well to pause before adopting this conclusion, because the original story, of which I have set forth only the broad outlines, contains a great many statements which rest upon just the same foundation as those cited, and yet are hardly likely to meet with general acceptance. The account of the circumstances which led up to the flood, of those under which Hasisadra's adventure was made known to his descendant, of certain remarkable incidents before and after the flood, are inseparably bound up with the details already given. And I am unable to discover any justification for arbitrarily picking out some of these and dubbing them historical verities, while rejecting the rest as legendary fictions. They stand or fall together.

Before proceeding to the consideration of these [253] less satisfactory details, it is needful to remark that Hasisadra's adventure is a mere episode in a cycle of stories of which a personage, whose name is provisionally read "Izdubar," is the centre. The nature of Izdubar hovers vaguely between the heroic and the divine; sometimes he seems a mere man, sometimes approaches so closely to the divinities of fire

and of the sun as to be hardly distinguishable from them. As I have already mentioned, the tablet which sets forth Hasisadra's perils is one of twelve; and, since each of these represents a month and bears a story appropriate to the corresponding sign of the Zodiac, great weight must be attached to Sir Henry Rawlinson's suggestion that the epos of Izdubar is a poetical embodiment of solar mythology.

In the earlier books of the epos, the hero, not content with rejecting the proffered love of the Chaldæan Aphrodite, Istar, freely expresses his very low estimate of her character; and it is interesting to observe that, even in this early stage of human experience, men had reached a conception of that law of nature which expresses the inevitable consequences of an imperfect appreciation of feminine charms. The injured goddess makes Izdubar's life a burden to him, until at last, sick in body and sorry in mind, he is driven to seek aid and comfort from his forbears in the world of spirits. So this antitype of Odysseus journeys to the shore of the waters of death, and [254] there takes ship with a Chaldæan Charon, who carries him within hail of his ancestor Hasisadra. That venerable personage not only gives Izdubar instructions how to regain his health, but tells him, somewhat *à propos des bottes* (after the manner of venerable personages), the long story of his perilous adventure; and how it befell that he, his wife, and his steersman came to dwell among the blessed gods, without passing through the portals of death like ordinary mortals.

According to the full story, the sins of mankind had become grievous; and, at a council of the gods, it was resolved to extirpate the whole race by a great flood. And, once more, let us note the uniformity of human experience. It would appear that, four thousand years ago, the obligations of confidential intercourse about matters of state were sometimes violated–of course from the best of motives. Ea, one of the three chiefs of the Chaldæan Pantheon, the god of justice and of practical wisdom, was also the god of the sea; and, yielding to the temptation to do a friend a good turn, irresistible to kindly seafaring folks of all ranks, he warned Hasisadra of what was coming. When Bel subsequently reproached him for this breach of confidence, Ea defended himself by declaring that he did not tell Hasisadra anything; he only sent him a dream. This was undoubtedly sailing very near the wind; but the attribution of a little benevolent obliquity of conduct to one of the [255] highest of the gods is a trifle compared with the truly Homeric anthropomorphism which characterises other parts of the epos.

The Chaldæan deities are, in truth, extremely human; and, occasionally, the narrator does not scruple to represent them in a manner which is not only inconsistent with our idea of reverence, but is sometimes distinctly humorous.[7] When the storm is at its height, he exhibits them flying in a state of panic to Anu, the god of heaven, and crouching before his portal like frightened dogs. As the smoke of Hasisadra's sacrifice arises, the gods, attracted by the sweet savour, are compared to swarms of flies. I have already remarked that the lady Istar's reputation is torn to shreds; while she and Ea scold Bel handsomely for his ferocity and injustice in destroying the innocent along with the guilty. One is reminded of Here hung up with weighted heels; of misleading dreams sent by Zeus; of Ares howling as he flies from the Trojan battlefield; and of the very questionable dealings of Aphrodite with Helen and Paris.

But to return to the story. Bel was, at first, excluded from the sacrifice as the author of all the mischief; which really was somewhat hard upon him, since the other gods agreed to his proposal. But eventually a

reconciliation takes place; the great bow of Anu is displayed in the heavens; Bel [256] agrees that he will be satisfied with what war, pestilence, famine, and wild beasts can do in the way of destroying men; and that, henceforward, he will not have recourse to extraordinary measures. Finally, it is Bel himself who, by way of making amends, transports Hasisadra, his wife, and the faithful Nes-Hea to the abode of the gods.

It is as indubitable as it is incomprehensible to most of us, that, for thousands of years, a great people, quite as intelligent as we are, and living in as high a state of civilisation as that which had been attained in the greater part of Europe a few centuries ago, entertained not the slightest doubt that Anu, Bel, Ea, Istar, and the rest, were real personages, possessed of boundless powers for good and evil. The sincerity of the monarchs whose inscriptions gratefully attribute their victories to Merodach, or to Assur, is as little to be questioned as that of the authors of the hymns and penitential psalms which give full expression to the heights and depths of religious devotion. An "infidel" bold enough to deny the existence, or to doubt the influence, of these deities probably did not exist in all Mesopotamia; and even constructive rebellion against their authority was apt to end in the deprivation, not merely of the good name, but of the skin of the offender. The adherents of modern theological systems dismiss these objects of the love and fear of a hundred generations of their equals, offhand, as "gods of the [257] heathen," mere creations of a wicked and idolatrous imagination; and, along with them, they disown, as senseless, the crude theology, with its gross anthropomorphism and its low ethical conception of the divinity, which satisfied the pious souls of Chaldæa.

I imagine, though I do not presume to be sure, that any endeavour to save the intellectual and moral credit of Chaldæan religion, by suggesting the application to it of that universal solvent of absurdities, the allegorical method, would be scouted; I will not even suggest that any ingenuity can be equal to the discovery of the antitypes of the personifications effected by the religious imagination of later ages, in the triad Anu, Ea, and Bel, still less in Istar. Therefore, unless some plausible reconciliatory scheme should be propounded by a Neo-Chaldæan devotee (and, with Neo-Buddhists to the fore, this supposition is not so wild as it looks), I suppose the moderns will continue to smile, in a superior way, at the grievous absurdity of the polytheistic idolatry of these ancient people.

It is probably a congenital absence of some faculty which I ought to possess which withholds me from adopting this summary procedure. But I am not ashamed to share David Hume's want of ability to discover that polytheism is, in itself, altogether absurd. If we are bound, or permitted, to judge the government of the world by human [258] standards, it appears to me that directorates are proved, by familiar experience, to conduct the largest and the most complicated concerns quite as well as solitary despots. I have never been able to see why the hypothesis of a divine syndicate should be found guilty of innate absurdity. Those Assyrians, in particular, who held Assur to be the one supreme and creative deity, to whom all the other supernal powers were subordinate, might fairly ask that the essential difference between their system and that which obtains among the great majority of their modern theological critics should be demonstrated. In my apprehension, it is not the quantity, but the quality, of the persons, among whom the attributes of divinity are distributed, which is the serious matter. If the divine might is associated with no higher ethical attributes than those which obtain among ordinary men; if the divine intelligence is supposed to be so imperfect that it cannot foresee the consequences of its

own contrivances; if the supernal powers can become furiously angry with the creatures of their omnipotence and, in their senseless wrath, destroy the innocent along with the guilty; or if they can show themselves to be as easily placated by presents and gross flattery as any oriental or occidental despot; if, in short, they are only stronger than mortal men and no better, as it must be admitted Hasisadra's deities proved themselves to be–then, surely, it is time for us to look some[259]what closely into their credentials, and to accept none but conclusive evidence of their existence.

To the majority of my respected contemporaries this reasoning will doubtless appear feeble, if not worse. However, to my mind, such are the only arguments by which the Chaldæan theology can be satisfactorily upset. So far from there being any ground for the belief that Ea, Anu, and Bel are, or ever were, real entities, it seems to me quite infinitely more probable that they are products of the religious imagination, such as are to be found everywhere and in all ages, so long as that imagination riots uncontrolled by scientific criticism.

It is on these grounds that I venture, at the risk of being called an atheist by the ghosts of all the principals of all the colleges of Babylonia, or by their living successors among the Neo-Chaldæans, if that sect should arise, to express my utter disbelief in the gods of Hasisadra. Hence, it follows, that I find Hasisadra's account of their share in his adventure incredible; and, as the physical details of the flood are inseparable from its theophanic accompaniments, and are guaranteed by the same authority, I must let them go with the rest. The consistency of such details with probability counts for nothing. The inhabitants of Chaldæa must always have been familiar with inundations; probably no generation failed to witness an inundation which rose [260] unusually high, or was rendered serious by coincident atmospheric or other disturbances. And the memory of the general features of any exceptionally severe and devastating flood, would be preserved by popular tradition for long ages. What, then, could be more natural than that a Chaldæan poet should seek for the incidents of a great catastrophe among such phenomena? In what other way than by such an appeal to their experience could he so surely awaken in his audience the tragic pity and terror? What possible ground is there for insisting that he must have had some individual good in view, and that his history is historical, in the sense that the account of the effects of a hurricane in the Bay of Bengal, in the year 1875, is historical?

More than three centuries after the time of Assurbanipal, Berosus of Babylon, born in the reign of Alexander the Great, wrote an account of the history of his country in Greek. The work of Berosus has vanished; but extracts from it–how far faithful is uncertain–have been preserved by later writers. Among these occurs the well-known story of the Deluge of Xisuthros, which is evidently built upon the same foundation as that of Hasisadra. The incidents of the divine warning, the building of the ship, the sending out of birds, the ascension of the hero, betray [261] their common origin. But stories, like Madeira, acquire a heightened flavour with time and travel; and the version of Berosus is characterised by those circumstantial improbabilities which habitually gather round the legend of a legend. The later narrator knows the exact day of the month on which the flood began. The dimensions of the ship are stated with Munchausenian precision at five stadia by two–say, half by one-fifth of an English mile. The ship runs aground among the "Gordæan mountains" to the south of Lake Van, in Armenia, beyond the limits of any imaginable real inundation of the Euphrates valley; and, by way of climax, we have the assertion, worthy of the sailor who said that he had brought up one of Pharaoh's chariot wheels on the

fluke of his anchor in the Red Sea, that pilgrims visited the locality and made amulets of the bitumen which they scraped off from the still extant remains of the mighty ship of Xisuthros.

Suppose that some later polyhistor, as devoid of critical faculty as most of his tribe, had found the version of Berosus, as well as another much nearer the original story; that, having too much respect for his authorities to make up a *tertium quid* of his own, out of the materials offered, he followed a practice, common enough among ancient and, particularly, among Semitic historians, of dividing, both into fragments and piecing these [262] together, without troubling himself very much about those resulting repetitions and inconsistencies; the product of such a primitive editorial operation would be a narrative analogous to that which treats of the Noachian deluge in the book of Genesis. For the Pentateuchal story is indubitably a patchwork, composed of fragments of at least two, different and partly discrepant, narratives, quilted together in such an inartistic fashion that the seams remain conspicuous. And, in the matter of circumstantial exaggeration, it in some respects excels even the second-hand legend of Berosus.

There is a certain practicality about the notion of taking refuge from floods and storms in a ship provided with a steersman; but, surely, no one who had ever seen more water than he could wade through would dream of facing even a moderate breeze, in a huge three-storied coffer, or box, three hundred cubits long, fifty wide and thirty high, left to drift without rudder or pilot.[8] Not content with giving the exact year of Noah's [263] age in which the flood began, the Pentateuchal story adds the month and the day of the month. It is the Deity himself who "shuts in" Noah. The modest week assigned to the full deluge in Hasisadra's story becomes forty days, in one of the Pentateuchal accounts, and a hundred and fifty in the other. The flood, which, in the version of Berosus, has grown so high as to cast the ship among the mountains of Armenia, is improved upon in the Hebrew account until it covers "all the high hills that were under the whole heaven"; and, when it begins to subside, the ark is left stranded on the summit of the highest peak, commonly identified with Ararat itself

While the details of Hasisadra's adventure are, at least, compatible with the physical conditions of the Euphrates valley, and, as we have seen, involve no catastrophe greater than such as might be brought under those conditions, many of the very precisely stated details of Noah's flood contradict some of the best established results of scientific inquiry.

If it is certain that the alluvium of the Mesopotamian plain has been brought down by the Tigris and the Euphrates, then it is no less certain that the physical structure of the whole valley has persisted, without material modification, for many thousand years before the date assigned to the flood. If the summits, even of [264] the moderately elevated ridges which immediately bound the valley, still more those of the Kurdish and Armenian mountains, were ever covered by water, for even forty days, that water must have extended over the whole earth. If the earth was thus covered, anywhere between 4000 and 5000 years ago, or, at any other time, since the higher terrestrial animals came into existence, they must have been destroyed from the whole face of it, as the Pentateuchal account declares they were three several times (Genesis vii. 21, 22, 23), in language which cannot be made more emphatic, or more solemn, than it is; and the present population must consist of the descendants of emigrants from the ark. And, if that is the case, then, as has often been pointed out, the sloths of the Brazilian forests, the kangaroos of Australia,

the great tortoises of the Galapagos islands, must have respectively hobbled, hopped, and crawled over many thousand miles of land and sea from "Ararat" to their present habitations. Thus, the unquestionable facts of the geographical distribution of recent land animals, alone, form an insuperable obstacle to the acceptance of the assertion that the kinds of animals composing the present terrestrial fauna have been, at any time, universally destroyed in the way described in the Pentateuch.

It is upon this and other unimpeachable grounds that, as I ventured to say some time ago, [265] persons who are duly conversant with even the elements of natural science decline to take the Noachian deluge seriously; and that, as I also pointed out, candid theologians, who, without special scientific knowledge, have appreciated the weight of scientific arguments, have long since given it up. But, as Goethe has remarked, there is nothing more terrible than energetic ignorance;[9] and there are, even yet, very energetic people, who are neither candid, nor clear-headed, nor theologians, still less properly instructed in the elements of natural science, who make prodigious efforts to obscure the effect of these plain truths, and to conceal their real surrender of the historical character of Noah's deluge under cover of the smoke of a great discharge of pseudoscientific artillery. They seem to imagine that the proofs which abound in all parts of the world, of large oscillations of the relative level of land and sea, combined with the probability that, when the sea-level was rising, sudden incursions of the sea like that which broke in over Holland and formed the Zuyder Zee, may have often occurred, can be made to look like evidence that something that, by courtesy, might be called a general Deluge has really taken place. Their discursive energy drags misunderstood truth into their service; and "the glacial epoch" is as sure to crop up among them [266] as King Charles's head in a famous memorial–with about as much appropriateness. The old story of the raised beach on Moel Tryfaen is trotted out; though, even if the facts are as yet rightly interpreted, there is not a shadow of evidence that the change of sea-level in that locality was sudden, or that glacial Welshmen would have known it was taking place.[10] Surely it is difficult to perceive the relevancy of bringing in something that happened in the glacial epoch (if it did happen) to account for the tradition of a flood in the Euphrates valley between 2000 and 3000 B.C. But the date of the Noachian flood is solidly fixed by the sole authority for it; no shuffling of the chronological data will carry it so far back as 3000 B.C.; and the Hebrew epos agrees with the Chaldæan in placing it after the development of a somewhat advanced civilisation. The only authority for the Noachian deluge assures us that, before it visited the earth, Cain had built cities; Jubal had invented harps and organs; while mankind had advanced so far beyond the neolithic, nay even the bronze, stage that Tubal-cain was a worker in iron. Therefore, if the Noachian legend is to be taken for the history of an event which happened in the glacial epoch, we must revise our notions of pleistocene [267] civilisation. On the other hand, if the Pentateuchal story only means something quite different, that happened somewhere else, thousands of years earlier, dressed up, what becomes of its credit as history? I wonder what would be said to a modern historian who asserted that Pekin was burnt down in 1886, and then tried to justify the assertion by adducing evidence of the Great Fire of London in 1666. Yet the attempt to save the credit of the Noachian story by reference to something which is supposed to have happened in the far north, in the glacial epoch, is far more preposterous.

Moreover, these dust-raising dialecticians ignore some of the most important and well-known facts which bear upon the question. Anything more than a parochial acquaintance with physical geography

and geology would suffice to remind its possessor that the Holy Land itself offers a standing protest against bringing such a deluge as that of Noah anywhere near it, either in historical times or in the course of that pleistocene period, of which the "great ice age" formed a part.

Judæa and Galilee, Moab and Gilead, occupy part of that extensive tableland at the summit of the western boundary of the Euphrates valley, to which I have already referred. If that valley had ever been filled with water to a height sufficient, not indeed to cover a third of Ararat, in the north, or half of some of the mountains of the [268] Persian frontier in the east, but to reach even four or five thousand feet, it must have stood over the Palestinian hog's back, and have filled, up to the brim, every depression on its surface. Therefore it could not have failed to fill that remarkable trench in which the Dead Sea, the Jordan, and the Sea of Galilee lie, and which is known as the "Jordan-Arabah" valley.

This long and deep hollow extends more than 200 miles, from near the site of ancient Dan in the north, to the water-parting at the head of the Wady Arabah in the south; and its deepest part, at the bottom of the basin of the Dead Sea, lies 2500 feet below the surface of the adjacent Mediterranean. The lowest portion of the rim of the Jordan-Arabah valley is situated at the village of El Fuleh, 257 feet above the Mediterranean. Everywhere else the circumjacent heights rise to a very much greater altitude. Hence, of the water which stood over the Syrian tableland, when as much drained off as could run away, enough would remain to form a "Mere" without an outlet, 2757 feet deep, over the present site of the Dead Sea. From this time forth, the level of the Palestinian mere could be lowered only by evaporation. It is an extremely interesting fact, which has happily escaped capture for the purposes of the energetic misunderstanding, that the valley, at one time, was filled, certainly within 150 feet of this height–probably higher. And it [269] is almost equally certain, that the time at which this great Jordan-Arabah mere reached its highest level coincides with the glacial epoch. But then the evidence which goes to prove this, also leads to the conclusion that this state of things obtained at a period considerably older than even 4000 B.C., when the world, according to the "Helps" (or shall we say "Hindrances") provided for the simple student of the Bible, was created; that it was not brought about by any diluvial catastrophe, but was the result of a change in the relative activities of certain natural operations which are quietly going on now; and that, since the level of the mere began to sink, many thousand years ago, no serious catastrophe of any description has affected the valley.

The evidence that the Jordan-Arabah valley really was once filled with water, the surface of which reached within 160 feet of the level of the pass of Jezrael, and possibly stood higher, is this: Remains of alluvial strata, containing shells of the freshwater mollusks which still inhabit the valley, worn down into terraces by waves which long rippled at the same level, and furrowed by the channels excavated by modern rainfalls, have been found at the former height; and they are repeated, at intervals, lower down, until the Ghor, or plain of the Jordan, itself an alluvial deposit, is reached. These strata attain a considerable thickness; and they indicate that the epoch at [270] which the freshwater mere of Palestine reached its highest level is extremely remote; that its diminution has taken place very slowly, and with periods of rest, during which the first formed deposits were cut down into terraces. This conclusion is strikingly borne out by other facts. A volcanic region stretches from Galilee to Gilead and the Hauran, on each side of the northern end of the valley. Some of the streams of basaltic lava which have been thrown out from its craters and clefts in times of which history has no record, have run athwart the

course of the Jordan itself, or of that of some of its tributary streams. The lava streams, therefore, must be of later date than the depressions they fill. And yet, where they have thus temporarily dammed the Jordan and the Jermuk, these streams have had time to cut through the hard basalts and lay bare the beds, over which, before the lava streams invaded them, they flowed.

In fact, the antiquity of the present Jordan-Arabah valley, as a hollow in a tableland, out of reach of the sea, and troubled by no diluvial or other disturbances, beyond the volcanic eruptions of Gilead and of Galilee, is vast, even as estimated by a geological standard. No marine deposits of later than miocene age occur in or about it; and there is every reason to believe that the Syro-Arabian plateau has been dry land, throughout the pliocene and later epochs, down to the present [271] time. Raised beaches, containing recent shells, on the Levantine shores of the Mediterranean and on those of the Red Sea, testify to a geologically recent change of the sea level to the extent of 250 or 300 feet, probably produced by the slow elevation of the land; and, as I have already remarked, the alluvial plain of the Euphrates and Tigris appears to have been affected in the same way, though seemingly to a less extent. But of violent, or catastrophic, change there is no trace. Even the volcanic outbursts have flowed in even sheets over the old land surface; and the long lines of the horizontal terraces which remain, testify to the geological insignificance of such earthquakes as have taken place. It is, indeed, possible that the original formation of the valley may have been determined by the well-known fault, along which the western rocks are relatively depressed and the eastern elevated. But, whether that fault was effected slowly or quickly, and whenever it came into existence, the excavation of the valley to its present width, no less than the sculpturing of its steep walls and of the innumerable deep ravines which score them down to the very bottom, are indubitably due to the operation of rain and streams, during an enormous length of time, without interruption or disturbance of any magnitude. The alluvial deposits which have been mentioned are continued into the lateral ravines, and have more or less filled them. But, since the waters [272] have been lowered, these deposits have been cut down to great depths, and are still being excavated by the present temporary, or permanent, streams. Hence, it follows, that all these ravines must have existed before the time at which the valley was occupied by the great mere. This fact acquires a peculiar importance when we proceed to consider the grounds for the conclusion that the old Palestinian mere attained its highest level in the cold period of the pleistocene epoch. It is well known that glaciers formerly came low down on the flanks of Lebanon and Antilebanon; indeed, the old moraines are the haunts of the few survivors of the famous cedars. This implies a perennial snowcap of great extent on Hermon; therefore, a vastly greater supply of water to the sources of the Jordan which rise on its flanks; and, in addition, such a total change in the general climate, that the innumerable Wadys, now traversed only by occasional storm torrents, must have been occupied by perennial streams. All this involves a lower annual temperature and a moist and rainy atmosphere. If such a change of meteorological conditions could be effected now, when the loss by evaporation from the surface of the Dead Sea salt-pan balances all the gain from the Jordan and other streams, the scale would be turned in the other direction. The waters of the Dead Sea would become diluted; its level would rise; it would cover, first the plain of the Jordan, then the [273] lake of Galilee, then the middle Jordan between this lake and that of Huleh (the ancient Merom); and, finally, it would encroach, northwards, along the course of the upper Jordan, and, southwards, up the Wady Arabah, until it reached some 260 feet above the level of the Mediterranean, when it would attain a permanent level, by sending any superfluity through the pass of Jezrael to swell the waters of the Kishon, and flow thence into the Mediterranean.

Reverse the process, in consequence of the excess of loss by evaporation over gain by inflow, which must have set in as the climate of Syria changed after the end of the pleistocene epoch, and (without taking into consideration any other circumstances) the present state of things must eventually be reached–a concentrated saline solution in the deepest part of the valley–water, rather more charged with saline matter than ordinary fresh water, in the lower Jordan and the lake of Galilee–fresh waters, still largely derived from the snows of Hermon, in the upper Jordan and in Lake Huleh. But, if the full state of the Jordan valley marks the glacial epoch, then it follows that the excavation of that valley by atmospheric agencies must have occupied an immense antecedent time–a large part, perhaps the whole, of the pliocene epoch; and we are thus forced to the conclusion that, since the miocene epoch, the physical conformation of the Holy Land has been substantially what it is now. [274] It has been more or less rained upon, searched by earthquakes here and there, partially overflowed by lava streams, slowly raised (relatively to the sea-level) a few hundred feet. But there is not a shadow of ground for supposing that, throughout all this time, terrestrial animals have ceased to inhabit a large part of its surface; or that, in many parts, they have been, in any respect, incommoded by the changes which have taken place.

The evidence of the general stability of the physical conditions of Western Asia, which is furnished by Palestine and by the Euphrates Valley, is only fortified if we extend our view northwards to the Black Sea and the Caspian. The Caspian is a sort of magnified replica of the Dead Sea. The bottom of the deepest part of this vast inland mere is about 3000 feet below the level of the Mediterranean, while its surface is lower by 85 feet. At present, it is separated, on the west, by wide spaces of dry land from the Black Sea, which has the same height as the Mediterranean; and, on the east, from the Aral, 138 feet above that level. The waters of the Black Sea, now in communication with the Mediterranean by the Dardanelles and the Bosphorus, are salt, but become brackish northwards, where the rivers of the steppes pour in a great volume of fresh water. Those of the shallower northern half of the Caspian are similarly affected by the Volga and the Ural, while, in the shallow bays of the [275] southern division, they become extremely saline in consequence of the intense evaporation. The Aral Sea, though supplied by the Jaxartes and the Oxus, has brackish water. There is evidence that, in the pliocene and pleistocene periods, to go no farther back, the strait of the Dardanelles did not exist, and that the vast area, from the valley of the Danube to that of the Jaxartes, was covered by brackish or, in some parts, fresh water to a height of at least 200 feet above the level of the Mediterranean. At the present time, the water-parting which separates the northern part of the basin of the Caspian from the vast plains traversed by the Tobol and the Obi, in their course to the Arctic Ocean, appears to be less than 200 feet above the latter. It would seem, therefore, to be very probable that, under the climatal conditions of part of the pleistocene period, the valley of the Obi played the same part in relation to the Ponto-Aralian sea, as that of the Kishon may have done to the great mere of the Jordan valley; and that the outflow formed the channel by which the well-known Arctic elements of the fauna of the Caspian entered it. For the fossil remains imbedded in the strata continuously deposited in the Aralo-Caspian area, since the latter end of the miocene epoch, show no sign that, from that time onward, it has ever been covered by sea water. Therefore, the supposition of a free inflow of the Arctic Ocean, which at one [276] time was generally received, as well as that of various hypothetical deluges from that quarter, must be seriously questioned.

The Caspian and the Aral stand in somewhat the same relation to the vast basin of dry land in which

they lie, as the Dead Sea and the lake of Galilee to the Jordan valley. They are the remains of a vast, mostly brackish, mere, which has dried up in consequence of the excess of evaporation over supply, since the cold and damp climate of the pleistocene epoch gave place to the increasing dryness and great summer heats of Central Asia in more modern times. The desiccation of the Aralo-Caspian basin, which communicated with the Black Sea only by a comparatively narrow and shallow strait along the present valley of Manytsch, the bottom of which was less than 100 feet above the Mediterranean, must have been vastly aided by the erosion of the strait of the Dardanelles towards the end of the pleistocene epoch, or perhaps later. For the result of thus opening a passage for the waters of the Black Sea into the Mediterranean must have been the gradual lowering of its level to that of the latter sea. When this process had gone so far as to bring down the Black Sea water to within less than a hundred feet of its present level, the strait of Manytsch ceased to exist; and the vast body of fresh water brought down by the Danube, the Dnieper, the Don, and other South [277] Russian rivers was cut off from the Caspian, and eventually delivered into the Mediterranean. Thus, there is as conclusive evidence as one can well hope to obtain in these matters, that, north of the Euphrates valley, the physical geography of an area as large as all Central Europe has remained essentially unchanged, from the miocene period down to our time; just as, to the west of the Euphrates valley, Palestine has exhibited a similar persistence of geographical type. To the south, the valley of the Nile tells exactly the same story. The holes bored by miocene mollusks in the cliffs east and west of Cairo bear witness that, in the miocene epoch, it contained an arm of the sea, the bottom of which has since been gradually filled up by the alluvium of the Nile, and elevated to its present position. But the higher parts of the Mokattam and of the desert about Ghizeh, have been dry land from that time to this. Too little is known of the geology of Persia, at present, to allow any positive conclusion to be enunciated. But, taking the name to indicate the whole continental mass of Iran, between the valleys of the Indus and the Euphrates, the supposition that its physical geography has remained unchanged for an immensely long period is hardly rash. The country is, in fact, an enormous basin, surrounded on all sides by a mountainous rim, and subdivided within by ridges into plateaus and hollows, the bottom of [278] the deepest of which, in the province of Seistan, probably descends to the level of the Indian Ocean. These depressions are occupied by salt marshes and deserts, in which the waters of the streams which flow down the sides of the basin are now dissipated by evaporation. I am acquainted with no evidence that the present Iranian basin was ever occupied by the sea; but the accumulations of gravel over a great extent of its surface indicate long-continued water action. It is, therefore, a fair presumption that large lakes have covered much of its present deserts, and that they have dried up by the operation of the same changed climatal conditions as those which have reduced the Caspian and the Dead Sea to their present dimensions.[11]

Thus it would seem that the Euphrates valley, the centre of the fabled Noachian deluge, is also the centre of a region covering some millions of square miles of the present continents of Europe, Asia, and Africa, in which all the facts, relevant to the argument, at present known, converge to the conclusion that, since the miocene epoch, the essential features of its physical geography have remained unchanged; that it has neither been depressed below the sea, nor swept by diluvial [279] waters since that time; and that the Chaldæan version of the legend of a flood in the Euphrates valley is, of all those which are extant, the only one which is even consistent with probability, since it depicts a local inundation, not more severe than one which might be brought about by a concurrence of favourable conditions at the present day; and which might probably have been more easily effected when the Persian Gulf extended farther north.

Hence, the recourse to the "glacial epoch" for some event which might colourably represent a flood, distinctly asserted by the only authority for it to have occurred in historical times, is peculiarly unfortunate. Even a Welsh antiquary might hesitate over the supposition that a tradition of the fate of Moel Tryfaen, in the glacial epoch, had furnished the basis of fact for a legend which arose among people whose own experience abundantly supplied them with the needful precedents. Moreover, if evidence of interchanges of land and sea are to be accepted as "confirmations" of Noah's deluge, there are plenty of sources for the tradition to be had much nearer than Wales.

The depression now filled by the Red Sea, for example, appears to be, geologically, of very recent origin. The later deposits found on its shores, two or three hundred feet above the sea level, contain no remains older than those of the present fauna; while, as I have already mentioned, [280] the valley of the adjacent delta of the Nile was a gulf of the sea in miocene times. But there is not a particle of evidence that the change of relative level which admitted the waters of the Indian Ocean between Arabia and Africa, took place any faster than that which is now going on in Greenland and Scandinavia, and which has left their inhabitants undisturbed. Even more remarkable changes were effected, towards the end of, or since, the glacial epoch, over the region now occupied by the Levantine Mediterranean and the Ægean Sea. The eastern coast region of Asia Minor, the western of Greece, and many of the intermediate islands, exhibit thick masses of stratified deposits of later tertiary age and of purely lacustrine characters; and it is remarkable that, on the south side of the island of Crete, such masses present steep cliffs facing the sea, so that the southern boundary of the lake in which they were formed must have been situated where the sea now flows. Indeed, there are valid reasons for the supposition that the dry land once extended far to the west of the present Levantine coast, and not improbably forced the Nile to seek an outlet to the north-east of its present delta–a possibility of no small importance in relation to certain puzzling facts in the geographical distribution of animals in this region. At any rate, continuous land joined Asia Minor with the Balkan peninsula; and its surface bore deep fresh-[281] water lakes, apparently disconnected with the Ponto-Aralian sea. This state of things lasted long enough to allow of the formation of the thick lacustrine strata to which I have referred. I am not aware that there is the smallest ground for the assumption that the Ægean land was broken up in consequence of any of the "catastrophes" which are so commonly invoked.[12] For anything that appears to the contrary, the narrow, steep-sided, straits between the islands of the Ægean archipelago may have been originally brought about by ordinary atmospheric and stream action; and may then have been filled from the Mediterranean, during a slow submergence proceeding from the south northwards. The strait of the Dardanelles is bounded by undisturbed pleistocene strata forty feet thick, through which, to all appearance, the present passage has been quietly cut.

That Olympus and Ossa were torn asunder and the waters of the Thessalian basin poured forth, is a very ancient notion, and an often cited "confirmation" of Deucalion's flood. It has not yet ceased to be in vogue, apparently because those who entertain it are not aware that modern geological investigation has conclusively proved that the gorge of the Penens is as typical an [282] example of a valley of erosion as any to be seen in Auvergne or in Colorado.[13]

Thus, in the immediate vicinity of the vast expanse of country which can be proved to have been

untouched by any catastrophe before, during, and since the "glacial epoch," lie the great areas of the Ægean and the Red Sea, in which, during or since the glacial epoch, changes of the relative positions of land and sea have taken place, in comparison with which the submergence of Moel Tryfaen, with all Wales and Scotland to boot, does not come to much.

What, then, is the relevancy of talk about the "glacial epoch" to the question of the historical veracity of the narrator of the story of the Noachian deluge? So far as my knowledge goes, there is not a particle of evidence that destructive inundations were more common, over the general surface of the earth, in the glacial epoch than they have been before or since. No doubt the fringe of an ice-covered region must be always liable to them; but, if we examine the records of such catastrophes in historical times, those produced in the deltas of great rivers, or in lowlands like Holland, by sudden floods, combined with gales of wind or with unusual tides, far excel all others.

[283] With respect to such inundations as are the consequences of earthquakes, and other slight movements of the crust of the earth, I have never heard of anything to show that they were more frequent and severer in the quaternary or tertiary epochs than they are now. In the discussion of these, as of all other geological problems, the appeal to needless catastrophes is born of that impatience of the slow and painful search after sufficient causes, in the ordinary course of nature, which is a temptation to all, though only energetic ignorance nowadays completely succumbs to it.

POSTSCRIPT.

My best thanks are due to Mr. Gladstone for his courteous withdrawal of one of the statements to which I have thought it needful to take exception. The familiarity with controversy, to which Mr. Gladstone alludes, will have accustomed him to the misadventures which arise when, as sometimes will happen in the heat of fence, the buttons come off the foils. I trust that any scratch which he may have received will heal as quickly as my own flesh wounds have done.

A contribution to the last number of this Review (*The Nineteenth Century*) of a different order would be left unnoticed, were it not that my silence would convert me into an accessory to misrepresentations of a very grave character. However, I shall restrict myself to the barest possible statement of facts, leaving my readers to draw their own conclusions.

In an article entitled "**A Great Lesson**," published in this Review for September, 1887:

(1) The Duke of Argyll says the "overthrow of Darwin's speculations" (p. 301) concerning the origin of coral reefs, which [284] he fancied had taken place, had been received by men of science "with a grudging silence as far as public discussion is concerned" (p. 301).

The truth is that, as every one acquainted with the literature of the subject was well aware, the views supposed to have effected this overthrow had been fully and publicly discussed by Dana in the United States; by Geikie, Green, and Prestwich in this country; by Lapparent in France; and by Credner in Germany.

(2) The Duke of Argyll says "that no serious reply has ever been attempted" (p. 305).

The truth is that the highest living authority on the subject, Professor Dana, published a most weighty reply, two years before the Duke of Argyll committed himself to this statement.

(3) The Duke of Argyll uses the preceding products of defective knowledge, multiplied by excessive imagination, to illustrate the manner in which "certain accepted opinions" established "a sort of Reign of Terror in their own behalf" (P. 307).

The truth is that no plea, except that of total ignorance of the literature of the subject, can excuse the errors cited, and that the "Reign of Terror" is a purely subjective phenomenon.

(4) The letter in "Nature" for the 17th of November, 1887, to which I am referred, contains neither substantiation, nor retractation, of statements 1 and 2. Nevertheless, it repeats number 3. The Duke of Argyll says of his article that it "has done what I intended it to do. It has called wide attention to the influence of mere authority in establishing erroneous theories and in retarding the progress of scientific truth."

(5) The Duke of Argyll illustrates the influence of his fictitious "Reign of Terror" by the statement that Mr. John Murray "was strongly advised against the publication of his views in derogation of Darwin's long-accepted theory of the coral islands, and was actually induced to delay it for two years" (p.307). And in "Nature" for the l7th November, 1887, the Duke of Argyll states that he has seen a letter from Sir Wyville Thomson in which he "urged and almost insisted that Mr. Murray should withdraw the reading of his papers on the [285] subject from the Royal Society of Edinburgh. This was in February, 1877." The next paragraph, however, contains the confession: "No special reason was assigned." The Duke of Argyll proceeds to give a speculative opinion that "Sir Wyville dreaded some injury to the scientific reputation of the body of which he was the chief." Truly, a very probable supposition; but as Sir Wyville Thomson's tendencies were notoriously anti-Darwinian, it does not appear to me to lend the slightest justification to the Duke of Argyll's insinuation that the Darwinian "terror" influenced him. However, the question was finally set at rest by a letter which appeared in "Nature" (29th of December, 1887), in which the writer says that: "talking with Sir Wyville about 'Murray's new theory,' I asked what objection he had to its being brought before the public? The answer simply was: he considered that the grounds of the theory had not, as yet, been sufficiently investigated or sufficiently corroborated, and that therefore any immature dogmatic publication of it would do less than little service either to science or to the author of the paper."

Sir Wyville Thomson was an intimate friend of mine, and I am glad to have been afforded one more opportunity of clearing his character from the aspersions which have been so recklessly cast upon his good sense and his scientific honour.

(6) As to the "overthrow" of Darwin's theory, which, according to the Duke of Argyll, was patent to every unprejudiced person four years ago, I have recently become acquainted with a work, in which a really competent authority,[14] thoroughly acquainted with all the new lights which have been thrown upon the subject during the last ten years, pronounces the judgment; firstly, that some of the facts brought forward by Messrs. Murray and [286] Guppy against Darwin's theory are not facts; secondly, that the others are reconcilable with Darwin's theory; and, thirdly, that the theories of Messrs. Murray and Guppy "are contradicted by a series of important facts" (p. 13).

Perhaps I had better draw attention to the circumstance that Dr. Langenbeck writes under shelter of the guns of the fortress of Strasburg; and may therefore be presumed to be unaffected by those dreams of a "Reign of Terror" which seem to disturb the peace of some of us in these islands (April, 1891).

[See, on the subject of this note, the essay entitled "An Episcopal Trilogy" in the following volume.]

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[1] In May 1849 the Tigris at Bagdad rose 22-1/2 feet–5 feet above its usual rise–and nearly swept away the town. In 1831 a similarly exceptional flood did immense damage, destroying 7000 houses. See Loftus, *Chaldea and Susiana*, p. 7.

[2] See the instructive chapter on Hasisadra's flood in Suess, *Das Antlitz der Erde,* Abth. I. Only fifteen years ago a cyclone in the Bay of Bengal gave rise to a flood which covered 3000 square miles of the delta of the Ganges, 3 to 45 feet deep, destroying 100,000 people, innumerable cattle, houses, and trees. It broke inland on the rising ground of Tipperah, and may have swept a vessel from the sea that far, though I do not know that it did.

[3] See Cernik's maps in *Petermanns Mittheilungen,* Ergänzungashefte 44 and 45, 1875-76.

[4] I have not cited the dimensions given to the ships in most translations of the story, because there appears to be a doubt about them. Haupt (*Keilinschriftliche Sindfluth- Bericht,* p. 13) says that the figures are illegible.

[5] It is probable that a slow movement of elevation of the land at one time contributed to the result–perhaps does so still.

[6] At a comparatively recent period, the littoral margin of the Persian Gulf extended certainly 250 miles farther to the northwest than the present embouchure of the Shatt-el Arab. (Loftus, *Quarterly Journal of the Geological Society,* 1853, p. 251.) The actual extent of the marine deposit inland cannot be defined, as it is covered by later fluviatile deposits.

[7] Tiele (*Babylonisch-Assyrische Geschicthe,* pp. 572-3) has some very just remarks on this aspect of the epos.

[8] In the second volume of the *History of the Euphrates*, p. 637 Col. Chesney gives a very interesting account of the simple and rapid manner in which the people about Tekrit and in the marshes of Lemlum construct large barges, and make them water-tight with bitumen. Doubtless the practice is extremely ancient and as Colonel Chesney suggests, may possibly have furnished the conception of Noah's ark. But it is one thing to build a barge 44ft. long by 11ft. wide and 4ft. deep in the way described; and another to get a vessel of ten times the dimensions, so constructed, to hold together.

[9] "Es ist nichts schrecklicher als eine thätige Unwissenheit," *Maximen und Reflexionen,* iii.

[10] The well-known difficulties connected with this case have recently been carefully discussed by Mr. Bell in the

Transactions of the Geological Society of Glasgow.

11 An instructive parallel is exhibited by the "Great Basin" of North America. See the remarkable memoir on *Lake Bonneville* by Mr. G K. Gilbert, of the United States Geological Survey, just published.

12 It is true that earthquakes are common enough, but they are incompetent to produce such changes as those which have taken place.

13 See Teller, *Geologische Beschreibung des sud-östlichen Thessalien;* Denkschriften d. Akademie der Wissenschaften, Wien, Bd. xl. p. 199.

14 Dr. Langenbeck, *Die Theorien über die Entstehung der Korallen-Inseln und Korallen-Riffe* (p. 13), 1890.

THE HUXLEY FILE

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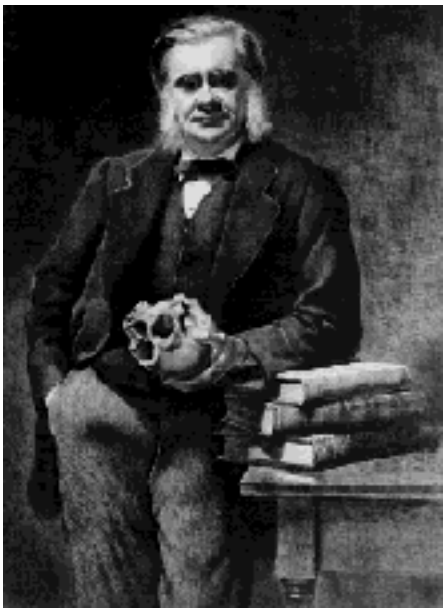

The Evolution of Theology: An Anthropological Study (1886)

Collected Essays IV

[287] I conceive that the origin, the growth, the decline, and the fall of those speculations respecting the existence, the powers, and the dispositions of beings analogous to men, but more or less devoid of corporeal qualities, which may be broadly included under the head of theology, are phenomena the study of which legitimately falls within the province of the anthropologist. And it is purely as a question of anthropology (a department of biology to which, at various times, I have given a good deal of attention) that I propose to treat of the evolution of theology in the following pages.

With theology as a code of dogmas which are to be believed, or at any rate repeated, under penalty of present or future punishment, or as a storehouse of anæsthetics for those who find the pains of life too hard to bear, I have nothing to [288] do; and, so far as it may be possible, I shall avoid the expression of any opinion as to the objective truth or falsehood of the systems of theological speculation of which I may find occasion to speak. From my present point of view, theology is regarded as a natural product of the operations of the human mind, under the conditions of its existence, just as any other branch of science, or the arts of architecture, or music, or painting are such products. Like them, theology has a history. Like them also, it is to be met with in certain simple and rudimentary forms; and these can be connected by a multitude of gradations, which exist or have existed, among people of various ages and races, with the most highly developed theologies of past and present times. It is not my object to interfere, even in the slightest degree, with beliefs which anybody holds sacred; or to alter the conviction of any one who is of opinion that, in dealing with theology, we ought to be guided by considerations different from those which would be thought appropriate if the problem lay in the province of chemistry or of mineralogy. And if people of these ways of thinking choose to read beyond the present paragraph, the responsibility for meeting with anything they may dislike rests with them and not with me.

We are all likely to be more familiar with the [289] theological history of the Israelites than with that of any other nation. We may therefore fitly make it the first object of our studies; and it will be convenient to commence with that period which lies between the invasion of Canaan and the early days of the monarchy, and answers to the eleventh and twelfth centuries B.C, or thereabouts. The evidence on which any conclusion as to the nature of Israelitic theology in those days must be based is wholly contained in the Hebrew Scriptures–an agglomeration of documents which certainly belong to very different ages, but of the exact dates and authorship of any one of which (except perhaps a few of the prophetical writings) there is no evidence, either internal or external, so far as I can discover, of such a nature as to justify more than a confession of ignorance, or, at most, an approximate conclusion. In this venerable record of ancient life, miscalled a book, when it is really a library comparable to a selection of works from English literature between the times of Beda and those of Milton, we have the stratified deposits (often confused and even with their natural order inverted) left by the stream of the intellectual and moral life of Israel during many centuries. And, embedded in these strata, there are numerous remains of forms of thought which once lived, and which, though often unfortunately mere fragments, are of

priceless value to the [289] anthropologist. Our task is to rescue these from their relatively unimportant surroundings, and by careful comparison with existing forms of theology to make the dead world which they record live again. In other words, our problem is palæontological, and the method pursued must be the same as that employed in dealing with other fossil remains.

Among the richest of the fossiliferous strata to which I have alluded are the books of Judges and Samuel.[1] It has often been observed that these writings stand out, in marked relief from those which precede and follow them, in virtue of a certain archaic freshness and of a greater freedom from traces of late interpolation and editorial trimming. Jephthah, Gideon and Samson are men of old heroic stamp, who would look as much in place in a Norse Saga as where they are; and if the varnish-brush of later respectability has passed over these memoirs of the mighty men of a wild age, here and there, it has not succeeded in effacing, or even in seriously [291] obscuring, the essential characteristics of the theology traditionally ascribed to their epoch.

There is nothing that I have met with in the results of Biblical criticism inconsistent with the conviction that these books give us a fairly trustworthy account of Israelitic life and thought in the times which they cover; and, as such, apart from the great literary merit of many of their episodes, they possess the interest of being, perhaps, the oldest genuine history, as apart from mere chronicles on the one hand and mere legends on the other, at present accessible to us.

But it is often said with exultation by writers of one party, and often admitted, more or less unwillingly, by their opponents, that these books are untrustworthy, by reason of being full of obviously unhistoric tales. And, as a notable example, the narrative of Saul's visit to the so-called "witch of Endor" is often cited. As I have already intimated, I have nothing to do with theological partisanship, either heterodox or orthodox, nor, for my present purpose, does it matter very much whether the story is historically true, or whether it merely shows what the writer believed; but, looking at the matter solely from the point of view of an anthropologist, I beg leave to express the opinion that the account of Saul's necromantic expedition is quite consistent with probability. That is to say, I see no reason [292] whatever to doubt, firstly, that Saul made such a visit; and, secondly, that he and all who were present, including the wise woman of Endor herself, would have given, with entire sincerity, very much the same account of the business as that which we now read in the twenty-eighth chapter of the first book of Samuel; and I am further of opinion that this story is one of the most important of those fossils, to which I have referred, in the material which it offers for the reconstruction of the theology of the time. Let us therefore study it attentively–not merely as a narrative which, in the dramatic force of its gruesome simplicity, is not surpassed, if it is equalled, by the witch scenes in Macbeth–but as a piece of evidence bearing on an important anthropological problem.

We are told (1 Sam. xxviii.) that Saul, encamped at Gilboa, became alarmed by the strength of the Philistine army gathered at Shunem. He therefore "inquired of Jahveh," but "Jahveh answered him not, neither by dreams, nor by Urim, nor by prophets."[2] Thus deserted by Jahveh, Saul, in his extremity, bethought him of "those that had familiar spirits, and the wizards," whom he is said, at some previous time, to have "put out of the land"; but who seem, nevertheless, to have been very imperfectly banished,

since [293] Saul's servants, in answer to his command to seek him a woman "that hath a familiar spirit," reply without a sign of hesitation or of fear, "Behold, there is a woman that hath a familiar spirit at Endor"; just as, in some parts of England, a countryman might tell any one who did not look like a magistrate or a policeman, where a "wise woman" was to be met with. Saul goes to this woman, who, after being assured of immunity, asks, "Whom shall I bring up to thee?" whereupon Saul says, "Bring me up Samuel." The woman immediately sees an apparition. But to Saul nothing is visible, for he asks, "What seest thou?" And the woman replies, "I see Elohim coming up out of the earth." Still the spectre remains invisible to Saul, for he asks, "What form is he of?" And she replies, "An old man cometh up, and he is covered with a robe." So far, therefore, the wise woman unquestionably plays the part of a "medium," and Saul is dependent upon her version of what happens.

The account continues:–

"And Saul perceived that it was Samuel, and he bowed with his face to the ground and did obeisance. And Samuel said to Saul, Why hast thou disquieted me to bring me up? And Saul answered, I am sore distressed: for the Philistines make war against me, and Elohim is departed from me and answereth me no more, neither by prophets nor by dreams; therefore I have called thee that thou mayest make known unto me what I shall do. And Samuel said, Wherefore then dost thou ask of me, seeing that Jahveh is departed from thee and is become thine [294] adversary? And Jahveh hath wrought for himself, as he spake by me, and Jahveh hath rent the kingdom out of thine hand and given it to thy neighbour, even to David. Because thou obeyedst not the voice of Jahveh and didst not execute his fierce wrath upon Amalek, therefore hath Jahveh done this thing unto thee this day. Moreover, Jahveh will deliver Israel also with thee into the hands of the Philistines; and to-morrow shalt thou and thy sons be with me: Jahveh shall deliver the host of Israel also into the hand of the Philistines. Then Saul fell straightway his full length upon the earth and was sore afraid because of the words of Samuel . . ." (v. 14-20).

The statement that Saul "perceived" that it was Samuel is not to be taken to imply that, even now, Saul actually saw the shade of the prophet, but only that the woman's allusion to the prophetic mantle and to the aged appearance of the spectre convinced him that it was Samuel. Reuss[3] in fact translates the passage "Alors Saul reconnut que c'était Samuel." Nor does the dialogue between Saul and Samuel necessarily, or probably, signify that Samuel spoke otherwise than by the voice of the wise woman. The Septuagint does not hesitate to call her [...] a ventriloquist, implying that it was she who spoke–and this view of the matter [295] is in harmony with the fact that the exact sense of the Hebrew words which are translated as "a woman that hath a familiar spirit" is "a woman mistress of *Ob*." *Ob* means primitively a leather bottle, such as a wine skin, and is applied alike to the necromancer and to the spirit evoked. Its use, in these senses, appears to have been suggested by the likeness of the hollow sound emitted by a half-empty skin when struck, to the sepulchral tones in which the oracles of the evoked spirits were uttered by the medium. It is most probable that, in accordance with the general theory of spiritual influences which obtained among the old Israelites, the spirit of Samuel was conceived to pass into the body of the wise woman, and to use her vocal organs to speak in his own name–for I cannot discover that they drew any clear distinction between possession and inspiration.[4]

If the story of Saul's consultation of the occult powers is to be regarded as an authentic narrative, or, at any rate, as a statement which is perfectly veracious so far as the intention of the narrator goes–and, as I

have said, I see no reason for refusing it this character–it will be found, on further consideration, to throw a flood of light, both directly and indirectly, on the theology of Saul's countrymen–that is to say, upon their [296] beliefs respecting the nature and ways of spiritual beings.

Even without the confirmation of other abundant evidences to the same effect, it leaves no doubt as to the existence, among them, of the fundamental doctrine that man consists of a body and of a spirit, which last, after the death of the body, continues to exist as a ghost. At the time of Saul's visit to Endor, Samuel was dead and buried; but that his spirit would be believed to continue to exist in Sheol may be concluded from the well-known passage in the song attributed to Hannah, his mother:–

> Jahveh killeth and maketh alive;
> He bringeth down to Sheol and bringeth up.

(1 Sam. ii. 6.)

And it is obvious that this Sheol was thought to be a place underground in which Samuel's spirit had been disturbed by the necromancer's summons, and in which, after his return thither, he would be joined by the spirits of Saul and his sons when they had met with their bodily death on the hill of Gilboa. It is further to be observed that the spirit, or ghost, of the dead man presents itself as the image of the man himself–it is the man, not merely in his ordinary corporeal presentment (even down to the prophet's mantle) but in his moral and intellectual characteristics. Samuel, who had begun as Saul's friend and ended as his bitter enemy, gives [297] it to be understood that he is annoyed at Saul's presumption in disturbing him; and that, in Sheol, he is as much the devoted servant of Jahveh and as much empowered to speak in Jahveh's name as he was during his sojourn in the upper air.

It appears now to be universally admitted that, before the exile, the Israelites had no belief in rewards and punishments after death, nor in anything similar to the Christian heaven and hell; but our story proves that it would be an error to suppose that they did not believe in the continuance of individual existence after death by a ghostly simulacrum of life. Nay, I think it would be very hard to produce conclusive evidence that they disbelieved in immortality; for I am not aware that there is anything to show that they thought the existence of the souls of the dead in Sheol ever came to an end. But they do not seem to have conceived that the condition of the souls in Sheol was in any way affected by their conduct in life. If there was immortality, there was no state of retribution in their theology. Samuel expects Saul and his sons to come to him in Sheol.

The next circumstance to be remarked is that the name of *Elohim* is applied to the spirit which the woman sees "coming up out of the earth," that is to say, from Sheol. The Authorised Version translates this in its literal sense "gods." The Revised Version gives "god" with "gods" in the margin. Reuss renders the word by "spectre," remarking in a note that it is not quite exact; but that the word Elohim expresses "something divine, that is to say, superhuman, commanding respect and terror" ("Histoire des Israelites," p. 321). Tuch, in his commentary on Genesis, and Thenius, in his commentary on Samuel, express substantially the same opinion. Dr. Alexander (in Kitto's "Cyclopædia" s. v. "God") has the following instructive remarks:–

"[*EIohim* is] sometimes used vaguely to describe unseen powers or superhuman beings that are not properly thought of as divine. Thus the witch of Endor saw "Elohim ascending out of the earth" (1 Sam. xxviii. 13), meaning thereby some beings of an unearthly, superhuman character. So also in Zechariah xii. 8, it is said "the house of David shall be as Elohim, as the angel of the Lord," where, as the transition from Elohim to the angel of the Lord is a minori ad majus, we must regard the former as a vague designation of supernatural powers."

Dr. Alexander speaks here of "beings"; but there is no reason to suppose that the wise woman of Endor referred to anything but a solitary spectre; and it is quite clear that Saul understood her in this sense, for he asks "What form is HE of?"

This fact, that the name of Elohim is applied to a ghost, or disembodied soul, conceived as the image of the body in which it once dwelt, is of no little importance. For it is well known that the same term was employed to denote the gods [299] of the heathen, who were thought to have definite quasi-corporeal forms and to be as much real entities as any other Elohim.[5] The difference which was supposed to exist between the different Elohim was one of degree, not one of kind. Elohim was, in logical terminology, the genus of which ghosts, Chemosh, Dagon, Baal, and Jahveh were species. The Israelite believed Jahveh to be immeasurably superior to all other kinds of Elohim. The inscription on the Moabite stone shows that King Mesa held Chemosh to be, as unquestionably, the superior of Jahveh. But if Jahveh was thus supposed to differ only in degree from the undoubtedly zoomorphic or anthropomorphic "gods of the nations," why is it to be assumed that he also was not thought of as having a human shape? It is possible for those who forget that the time of the great prophetic writers is at least as remote from that of Saul as our day is from that of Queen Elizabeth, to insist upon interpreting the gross notions current in the earlier age and among the mass of the people by the refined conceptions promulgated by a few select spirits centuries later. But if we take the language constantly used concerning the Deity in [300] the books of Genesis, Exodus, Joshua, Judges, Samuel, or Kings, in its natural sense (and I am aware of no valid reason which can be given for taking it in any other sense), there cannot, to my mind, be a doubt that Jahveh was conceived by those from whom the substance of these books is mainly derived, to possess the appearance and the intellectual and moral attributes of a man; and, indeed, of a man of just that type with which the Israelites were familiar in their stronger and intellectually abler rulers and leaders. In a well-known passage in Genesis (i. 27) Elohim is said to have "created man in his own image, in the image of Elohim created he him." It is "man" who is here said to be the image of Elohim–not man's soul alone, still less his "reason," but the whole man. It is obvious that for those who call a manlike ghost Elohim, there could be no difficulty in conceiving any other Elohim under the same aspect. And if there could be any doubt on this subject, surely it cannot stand in the face of what we find in the fifth chapter, where, immediately after a repetition of the statement that "Elohim created man, in the likeness of Elohim made he him," it is said that Adam begat Seth "in his own likeness, after his image." Does this mean that Seth resembled Adam only in a spiritual and figurative sense? And if that interpretation of the third verse of the fifth chapter of Genesis is absurd, why does it be[301]come reasonable in the first verse of the same chapter?

But let us go further. Is not the Jahveh who "walks in the garden in the cool of the day"; from whom one may hope to "hide oneself among the trees"; of whom it is expressly said that "Moses and Aaron, Nadab

and Abihu, and seventy of the elders of Israel," saw the Elohim of Israel (Exod. xxiv. 9-11); and that, although the seeing Jahveh was understood to be a high crime and misdemeanour, worthy of death, under ordinary circumstances, yet, for this once, he "laid not his hand on the nobles of Israel"; "that they beheld Elohim and did eat and drink"; and that afterwards Moses saw his back (Exod. xxxiii. 23)–is not this Deity conceived as manlike in form? Again, is not the Jahveh who eats with Abraham under the oaks at Mamre, who is pleased with the "sweet savour" of Noah's sacrifice, to whom sacrifices are said to be "food"[6]–is not this Deity depicted as possessed of human appetites? If this were not the current Israelitish idea of Jahveh even in the eighth century B.C., where is the point of Isaiah's scathing admonitions to his countrymen: "To what purpose is the multitude of your sacrifices unto me? saith Jahveh: I am full of the burnt-offerings of rams and the fat [302] of fed beasts; and I delight not in the blood of bullocks, or of lambs, or of he-goats" (Isa. i. 11). Or of Micah's inquiry, "Will Jahveh be pleased with thousands of rams or with ten thousands of rivers of oil?" (vi. 7.) And in the innumerable passages in which Jahveh is said to be jealous of other gods, to be angry, to be appeased, and to repent; in which he is represented as casting off Saul because the king does not quite literally execute a command of the most ruthless severity; or as smiting Uzzah to death because the unfortunate man thoughtlessly, but naturally enough, put out his hand to stay the ark from falling–can any one deny that the old Israelites conceived Jahveh not only in the image of a man, but in that of a changeable, irritable, and, occasionally, violent man? There appears to me, then, to be no reason to doubt that the notion of likeness to man, which was indubitably held of the ghost Elohim, was carried out consistently throughout the whole series of Elohim, and that Jahveh-Elohim was thought of as a being of the same substantially human nature as the rest, only immeasurably more powerful for good and for evil.

The absence of any real distinction between the Elohim of different ranks is further clearly illustrated by the corresponding absence of any sharp delimitation between the various kinds of people who serve as the media of communication between them and men. The agents through [303] whom the lower Elohim are consulted are called necromancers, wizards, and diviners, and are looked down upon by the prophets and priests of the higher Elohim; but the "seer"[7] connects the two, and they are all alike in their essential characters of media. The wise woman of Endor was believed by others, and, I have little doubt, believed herself, to be able to "bring up" whom she would from Sheol, and to be inspired, whether in virtue of actual possession by the evoked Elohim, or otherwise, with a knowledge of hidden things, I am unable to see that Saul's servant took any really different view of Samuel's powers, though he may have believed that he obtained them by the grace of the higher Elohim. For when Saul fails to find his father's asses, his servant says to him–

"Behold, there is in this city a man of Elohim, and he is a man that is held in honour; all that he saith cometh surely to pass; now let us go thither; peradventure, he can tell us concerning our journey whereon we go. Then said Saul to his servant, But behold if we go, what shall we bring the man? for the bread is spent in our vessels and there is not a present to bring to the man of Elohim. What have we? And the servant answered Saul again and said, Behold I have in my hand the fourth part of a shekel of silver: that will I give to the man of Elohim to tell us our way. (Beforetime in Israel when a man went to inquire of Elohim, then he said, Come and let us go to the Seer: for he that is now called a Prophet was beforetime called a Seer[8])" (1 Sam. ix. 6-10).

[304] In fact, when, shortly afterwards, Saul accidentally meets Samuel, he says, "Tell me, I pray thee, where the Seer's house is." Samuel answers, "I am the Seer." Immediately afterwards Samuel informs Saul that the asses are found, though how he obtained his knowledge of the fact is not stated. It will be observed that Samuel is not spoken of here as, in any special sense, a seer or prophet of Jahveh, but as a "man of Elohim"–that is to say, a seer having access to the "spiritual powers," just as the wise woman of Endor might have been said to be a "woman of Elohim"–and the narrator's or editor's explanatory note seems to indicate that "Prophet" is merely a name, introduced later than the time of Samuel, for a superior kind of "Seer," or "man of Elohim."[9]

Another very instructive passage shows that Samuel was not only considered to be diviner, seer, and prophet in one, but that he was also, to all intents and purposes, priest of Jahveh–though, according to his biographer, he was not a member of the tribe of Levi. At the outset of their acquaintance, Samuel says to Saul, "Go up before me into the high place," where, as the young maidens of the city had just before told Saul, the [305] Seer was going, "for the people will not eat till he come, because he doth bless the sacrifice" (1 Sam. x. 12). The use of the word "bless" here–as if Samuel were not going to sacrifice, but only to offer a blessing or thanksgiving–is curious. But that Samuel really acted as priest seems plain from what follows. For he not only asks Saul to share in the customary sacrificial feast, but he disposes in Saul's favour of that portion of the victim which the Levitical legislation, doubtless embodying old customs, recognises as the priest's special property.[10]

Although particular persons adopted the profession of media between men and Elohim, there was no limitation of the power, in the view of ancient Israel, to any special class of the population. Saul inquires of Jahveh and builds him altars on his own account; and in the very remarkable story told in the fourteenth chapter of the first book of Samuel (v. 37-46), Saul appears to conduct the whole process of divination, [306] although he has a priest at his elbow. David seems to do the same.

Moreover, Elohim constantly appear in dreams–which in old Israel did not mean that, as we should say, the subject of the appearance "dreamed he saw the spirit"; but that he veritably saw the Elohim which, as a soul, visited his soul while his body was asleep. And, in the course of the history of Israel Jahveh himself thus appears to all sorts of persons, non-Israelites as well as Israelites. Again, the Elohim possess, or inspire, people against their will, as in the case of Saul and Saul's messengers, and then these people prophesy–that is to say, "rave "–and exhibit the ungoverned gestures attributed by a later age to possession by malignant spirits. Apart from other evidence to be adduced by and by, the history of ancient demonology and of modern revivalism does not permit me to doubt that the accounts of these phenomena given in the history of Saul may be perfectly historical.

In the ritual practices, of which evidence is to be found in the books of Judges and Samuel, the chief part is played by sacrifices, usually burnt offerings. Whenever the aid of the Elohim of Israel is sought, or thanks are considered due to him, an altar is built, and oxen, sheep, and goats are slaughtered and offered up. Sometimes the entire victim is burnt as a holocaust; more frequently only certain parts, notably the fat [307] about the kidneys, are burnt on the altar. The rest is properly cooked; and, after the reservation of a part for the priest, is made the foundation of a joyous banquet, in which the sacrificer,

his family, and such guests as he thinks fit to invite, participate.[11] Elohim was supposed to share in the feast, and it has been already shown that that which was set apart on the altar, or consumed by fire, was spoken of as the food of Elohim, who was thought to be influenced by the costliness, or by the pleasant smell, of the sacrifice in favour of the sacrificer.

All this bears out the view that, in the mind of the old Israelite, there was no difference, save one of degree, between one Elohim and another. It is true that there is but little direct evidence to show that the old Israelites shared the widespread belief of their own, and indeed of all times, that the spirits of the dead not only continue to exist, but are capable of a ghostly kind of feeding and are grateful for such aliment as can be assimilated by their attenuated substance, and even for clothes, ornaments, and weapons.[12] That they [308] were familiar with this doctrine in the time of the captivity is suggested by the well-known reference of Ezekiel (xxxii. 27) to the "mighty that are fallen of the uncircumcised, which are gone down to [Sheol] hell with their weapons of war, and have laid their swords under their heads." Perhaps there is a still earlier allusion in the "giving of food for the dead" spoken of in Deuteronomy (xxvi. 14).[13]

It must be remembered that the literature of the old Israelites, as it lies before us, has been subjected to the revisal of strictly monotheistic editors, violently opposed to all kinds of idolatry, who are not likely to have selected from the materials at their disposal any obvious evidence, either of the practice under discussion, or of that ancestor-worship which is so closely related to it, [309] for preservation in the permanent records of their people.

The mysterious objects known as *Teraphim,* which are occasionally mentioned in Judges, Samuel, and elsewhere, however, can hardly be interpreted otherwise than as indications of the existence both of ancestor-worship and of image-worship in old Israel. The teraphim were certainly images of family gods, and, as such, in all probability represented deceased ancestors. Laban indignantly demands of his son-in-law, "Wherefore hast thou stolen my Elohim?" which Rachel, who must be assumed to have worshipped Jacob's God, Jahveh, had carried off, obviously because she, like her father, believed in their divinity. It is not suggested that Jacob was in any way scandalised by the idolatrous practices of his favourite wife, whatever he may have thought of her honesty when the truth came to light; for the teraphim seem to have remained in his camp, at least until he "hid" his strange gods "under the oak that was by Shechem" (Gen. xxxv. 4). And indeed it is open to question if he got rid of them then, for the subsequent history of Israel renders it more than doubtful whether the teraphim were regarded as "strange gods" even as late as the eighth century B.C.

The writer of the books of Samuel takes it quite as a matter of course that Michal, daughter of one royal Jahveh worshipper and wife of the [310] servant of Jahveh *par excellence,* the pious David, should have her teraphim handy, in her and David's chamber, when she dresses them up in their bed into a simulation of her husband, for the purpose of deceiving her father's messengers. Even one of the early prophets, Hosea, when he threatens that the children of Israel shall abide many days without "ephod or teraphim" (iii. 4), appears to regard both as equally proper appurtenances of the suspended worship of Jahveh, and equally certain to be restored when that is resumed. When we further take into consideration

that only in the reign of Hezekiah was the brazen serpent, preserved in the temple and believed to be the work of Moses, destroyed, and the practice of offering incense to it, that is, worshipping it, abolished–that Jeroboam could set up "calves of gold" for Israel to worship, with apparently none but a political object, and certainly with no notion of creating a schism among the worshippers of Jahveh, or of repelling the men of Judah from his standard–it seems obvious, either that the Israelites of the tenth and eleventh centuries B.C. knew not the second commandment, or that they construed it merely as part of the prohibition to worship any supreme god other than Jahveh, which precedes it.

In seeking for information about the teraphim, I lighted upon the following passage in the valuable article on that subject by Archdeacon [311] Farrar, in Ritto's "Cyclopædia of Biblical Literature," which is so much to the purpose of my argument, that I venture to quote it in full:–

"The main and certain results of this review are that the teraphim were rude human images; that the use of them was an antique Aramaic custom; that there is reason to suppose them to have been images of deceased ancestors; that they were consulted oracularly; that they were not confined to Jews; that their use continued down to the latest period of Jewish history; and lastly, that although the enlightened prophets and strictest later kings regarded them as idolatrous, the priests were much less averse to such images, and their cult was not considered in any way repugnant to the pious worship of Elohim, nay, even to the worship of him "under the awful title of Jehovah." In fact, they involved *a monotheistic idolatry very different indeed from polytheism;* and the tolerance of them by priests, as compared with the denunciation of them by the prophets, offers a close analogy to the views of the Roman Catholics respecting pictures and images as compared with the views of Protestants. It was against this use of idolatrous symbols and emblems in a monotheistic worship that the *second* commandment was directed, whereas the first is aimed against the graver sin of direct polytheism. But the whole history of Israel shows how utterly and how early the law must have fallen into desuetude. The worship of the golden calf and of the calves at Dan and Bethel, against which, so far as we know, neither Elijah nor Elisha said a single word; the tolerance of high places, teraphim and betylia; the offering of incense for centuries to the brazen serpent destroyed by Hezekiah; the occasional glimpses of the most startling irregularities sanctioned apparently even in the temple worship itself, prove most decisively that a pure monotheism and an independence of symbols was the result of a slow and painful course of God's disciplinal dealings among the noblest thinkers of a single nation, and not, as is so constantly and erroneously [312] urged, the instinct of the whole Semitic race; in other words, one single branch of the Semites was under God's providence *educated* into pure monotheism only by centuries of misfortune and series of inspired men" (vol. iii. p. 986).

It appears to me that the researches of the anthropologist lead him to conclusions identical in substance, if not in terms, with those here enunciated as the result of a careful study of the same subject from a totally different point of view.

There is abundant evidence in the books of Samuel and elsewhere that an article of dress termed an *ephod* was supposed to have a peculiar efficacy in enabling the wearer to exercise divination by means of Jahveh-Elohim. Great and long continued have been the disputes as to the exact nature of the ephod–whether it always means something to wear, or whether it sometimes means an image. But the probabilities are that it usually signifies a kind of waistcoat or broad zone, with shoulder-straps, which the person who "inquired of Jahveh" put on. In 1 Samuel xxiii. 2 David appears to have inquired without an ephod, for Abiathar the priest is said to have "come down with an ephod in his hand" only

subsequently. And then David asks for it before inquiring of Jahveh whether the men of Keilah would betray him or not. David's action is obviously divination pure and simple; and it is curious that he seems to have worn the ephod [313] himself and not to have employed Abiathar as a medium. How the answer was given is not clear though the probability is that it was obtained by casting lots. The *Urim* and *Thummim* seem to have been two such lots of a peculiarly sacred character, which were carried in the pocket of the high priest's "breastplate." This last was worn along with the ephod.

With the exception of one passage (1 Sam xiv. 18) the ark is ignored in the history of Saul. But in this place the Septuagint reads "ephod" for ark, while in 1 Chronicles xiii. 3 David says that "we sought not unto it [the ark] in the days of Saul." Nor does Samuel seem to have paid any regard to the ark after its return from Philistia; though, in his childhood, he is said to have slept in "the temple of Jahveh, where the ark of Elohim was" (1 Sam. iii. 3), at Shiloh and there to have been the seer of the earliest apparitions vouchsafed to him by Jahveh. The space between the cherubim or winged images on the canopy or cover (*Kapporeth*) of this holy chest was held to be the special seat of Jahveh–the place selected for a temporary residence of the Supreme Elohim who had, after Aaron and Phineas, Eli and his sons for priests and seers. And, when the ark was carried to the camp at Eben-ezer, there can be no doubt that the Israelites, no less than the Philistines, held that "Elohim is come into the camp" (iv. 7), and that [314] the one, as much as the other, conceived that the Israelites had summoned to their aid a powerful ally in "these (or this) mighty Elohim"–elsewhere called Jahve-Sabaoth, the Jahveh of Hosts. If the "temple" at Shiloh was the pentateuchal tabernacle, as is suggested by the name of "tent of meeting" given to it in 1 Samuel ii. 22, it was essentially a large tent, though constituted of very expensive and ornate materials; if, on the other hand, it was a different edifice, there can be little doubt that this "house of Jahveh" was built on the model of an ordinary house of the time. But there is not the slightest evidence that, during the reign of Saul, any greater importance attached to this seat of the cult of Jahveh than to others. Sanctuaries, and "high places" for sacrifice, were scattered all over the country from Dan to Beersheba. And, as Samuel is said to have gone up to one of these high places to bless the sacrifice, it may be taken for tolerably certain that he knew nothing of the Levitical laws which severely condemn the high places and those who sacrifice away from the sanctuary hallowed by the presence of the ark.

There is no evidence that, during the time of the Judges and of Samuel, any one occupied the position of the high priest of later days. And persons who were neither priests nor Levites sacrificed and divined or "inquired of Jahveh," [315] when they pleased and where they pleased, without the least indication that they, or any one else in Israel at that time, knew they were doing wrong. There is no allusion to any special observance of the Sabbath; and the references to circumcision are indirect.

Such are the chief articles of the theological creed of the old Israelites, which are made known to us by the direct evidence of the ancient record to which we have had recourse, and they are as remarkable for that which they contain as for that which is absent from them. They reveal a firm conviction that, when death takes place, a something termed a soul or spirit leaves the body and continues to exist in Sheol for a period of indefinite duration, even though there is no proof of any belief in absolute immortality; that such spirits can return to earth to possess and inspire the living; that they are, in appearance and in disposition, likenesses of the men to whom they belonged, but that, as spirits, they have larger powers and are freer from physical limitations; that they thus form a group among a number of kinds of spiritual

existences known as Elohim, of whom Jahveh, the national God of Israel, is one; that, consistently with this view, Jahveh was conceived as a sort of spirit, human in aspect and in senses, and with many human passions, but with immensely greater intelligence and power than [316] any other Elohim, whether human or divine. Further, the evidence proves that this belief was the basis of the Jahveh-worship to which Samuel and his followers were devoted; that there is strong reason for believing, and none for doubting, that idolatry, in the shape of the worship of the family gods or teraphim, was practised by sincere and devout Jahveh-worshippers; that the ark, with its protective tent or tabernacle, was regarded as a specially, but by no means exclusively, favoured sanctuary of Jahveh; that the ephod appears to have had a particular value for those who desired to divine by the help of Jahveh; and that divination by lots was practised before Jahveh. On the other hand, there is not the slightest evidence of any belief in retribution after death, but the contrary; ritual obligations have at least as strong sanction as moral; there are clear indications that some of the most stringent of the Levitical laws were unknown even to Samuel; priests often appear to be superseded by laymen, even in the performance of sacrifices and divination; and no line of demarcation can be drawn between necromancer, wizard, seer, prophet, and priest, each of whom is regarded, like all the rest, as a medium of communication between the world of Elohim and that of living men.

The theological system thus defined offers to the anthropologist no feature which is devoid of a [317] parallel in the known theologies of other races of mankind, even of those who inhabit parts of the world most remote from Palestine. And the foundation of the whole, the ghost theory, is exactly that theological speculation which is the most widely spread of all, and the most deeply rooted among uncivilised men. I am able to base this statement, to some extent, on facts within my own knowledge. In December 1848, H.M.S. *Rattlesnake*, the ship to which I then belonged, was anchored off Mount Ernest, an island in Torres Straits. The people were few and well disposed; and, when a friend of mine (whom I will call B.) and I went ashore, we made acquaintance with an old native, Paouda by name. In course of time we became quite intimate with the old gentleman, partly by the rendering of mutual good offices, but chiefly because Paouda believed he had discovered that B. was his father-in-law. And his grounds for this singular conviction were very remarkable. We had made a long stay at Cape York hard by; and, in accordance with a theory which is widely spread among the Australians, that white men are the reincarnated spirits of black men, B. was held to be the ghost, or *narki*, of a certain Mount Ernest native, one Antarki, who had lately died, on the ground of some real or fancied resemblance to the latter. Now Paouda had taken to wife a daughter of Antarki's, named Domani, and as soon as B. [318] informed him that he was the ghost of Antarki, Paouda at once admitted the relationship and acted upon it. For, as all the women on the island had hidden away in fear of the ship, and we were anxious to see what they were like, B. pleaded pathetically with Paouda that it would be very unkind not to let him see his daughter and grandchildren. After a good deal of hesitation and the exaction of pledges of deep secrecy, Paouda consented to take B., and myself as B.'s friend, to see Domani and the three daughters, by whom B. was received quite as one of the family, while I was courteously welcomed on his account.

This scene made an impression upon me which is not yet effaced. It left no question on my mind of the sincerity of the strange ghost theory of these savages, and of the influence which their belief has on their practical life. I had it in my mind, as well as many a like result of subsequent anthropological studies, when, in 1869,[14] I wrote as follows:–

"There are savages without God in any proper sense of the word, but none without ghosts. And the Fetishism, Ancestor-worship, Hero-worship, and Demonology of primitive savages are all, I believe, different manners of expression of their belief in ghosts, and of the anthropomorphic interpretation of out-of-the-way events which is its concomitant. Witchcraft and sorcery are the practical expressions of these beliefs; and they stand in the same relation to religious worship as the simple anthropomorphism of children or savages does to theology."

[319] I do not quote myself with any intention of making a claim to originality in putting forth this view; for I have since discovered that the same conception is virtually contained in the great "Discours sur l'Histoire Universelle" of Bossuet, now more than two centuries old:–

"Le culte des hommes morta faisoit presque tout le fond de l'idolâtrie; presque tous les hommes sacrificient aux manes, c'est-à-dire aux âmes des morts. De si anciennes erreurs nous font voir à la vérité combien étoit ancienne la croyance de l'immortalité de l'âme, et nous montrent qu'elle doit être rangée parmi les premières traditions du genre humain. Mais l'homme, qui gâtoit tout, en avoit étrangement abusé, puisqu'elle le portoit à sacrificer aux morts. On alloit même jusqu'à cet excès, de leur sacrifier des hommes vivans; ou tuoit leurs esclaves, et même leurs femmes, pour les aller servir dans l'autre monde."[15]

Among more modern writers J. G. Müller, in his excellent "Geschichte der amerikanischen Urreligionen" (1855), clearly recognises "gespensterhafter Geisterglaube" as the foundation of all savage and semi-civilised theology, and I need do no more than mention the important developments of the same view which are to be found ill Mr. Tylor's "Primitive Culture," and in the writings of Mr. Herbert Spencer, especially his recently-published "Ecclesiastical Institutions."[16]

[320] It is a matter of fact that, whether we direct our attention to the older conditions of civilised societies, in Japan, in China, in Hindostan, in Greece, or in Rome,[17] we find, underlying all other theological notions, the belief in ghosts, with its inevitable concomitant sorcery; and a primitive cult, in the shape of a worship of ancestors, which is essentially an attempt to please, or appease their ghosts. The same thing is true of old Mexico and Peru, and of all the semi-civilised or savage peoples who have developed a definite cult; and in those who, like the natives of Australia, have not even a cult, the belief in, and fear of, ghosts is as strong as anywhere else. The most clearly demonstrable article of the theology of the Israelites in the eleventh and twelfth centuries B.C. is therefore simply the article which is to be found in all primitive theologies, namely, the belief that a man has a soul which continues to exist after death for a longer or shorter time, and may return, as a ghost, with a divine, or at least demonic, character, to influence for good or evil (and usually for evil) the affairs of the living. But the correspondence between the old Israelitic and other archaic forms of theology extends to details. If, in order to avoid all chance of [321] direct communication, we direct our attention to the theology of semi-civilised people, such as the Polynesian Islanders, separated by the greatest possible distance, and by every conceivable physical barrier, from the inhabitants of Palestine, we shall find not merely that all the features of old Israelitic theology, which are revealed in the records cited, are found among them; but that extant information as to the inner mind of these people tends to remove many of the difficulties which those who have not studied anthropology find in the Hebrew narrative.

One of the best sources, if not the best source, of information on these topics is Mariner's *Tonga Islands*, which tells us of the condition of Cook's "Friendly Islanders" eighty years ago, before European influence was sensibly felt among them. Mariner, a youth of fair education and of no inconsiderable natural ability (as the work which was drawn up from the materials he furnished shows), was about fifteen years of age when his ship was attacked and plundered by the Tongans: he remained four years in the islands, familiarised himself with the language, lived the life of the people, became intimate with many of them, and had every opportunity of acquainting himself with their opinions, as well as with their habits and customs. He seems to have been devoid of prejudices, theological or other, and the impression of strict accuracy which his statements convey [322] has been justified by all the knowledge of Polynesian life which has been subsequently acquired.

It is desirable, therefore, to pay close attention to that which Mariner tells us about the theological views of these people:–

"The human soul,[18] after its separation from the body, is termed a *hotooa* (a god or spirit), and is believed to exist in the shape of the body; to have the same propensities as during life, but to be corrected by a more enlightened understanding, by which it readily distinguishes good from evil, truth from falsehood, right from wrong; having the same attributes as the original gods, but in a minor degree, and having its dwelling for ever in the happy regions of Bolotoo, holding the same rank in regard to other souls as during this life; it has, however, the power of returning to Tonga to inspire priests, relations, or others, or to appear in dreams to those it wishes to admonish; and sometimes to the external eye in the form of a ghost or apparition; but this power of reappearance at Tonga particularly belongs to the souls of chiefs rather than of matabooles" (vol. ii. p. 130).

The word "hotooa" is the same as that which is usually spelt "atua" by Polynesian philologues, and it will be convenient to adopt this spelling. Now under this head of "*Atuas* or supernatural intelligent beings" the Tongans include:–

"1. The original gods. 2. The souls of nobles that have all attributes in common with the first but inferior in degree. 3. The souls of matabooles[19] that are still inferior, and have not [323] the power as the two first have of coming back to Tonga to inspire the priest, though they are supposed to have the power of appearing to their relatives. 4. The original attendants or servants, as it were, of the gods, who, although they had their origin and have ever since existed in Bolotoo, are still inferior to the third class. 5. The *Atua pow* or mischievous gods. 6. *Mooi*, or the god that supports the earth and does not belong to Bolotoo" (vol. ii. pp. 103,104).

From this it appears that the "Atuas" of the Polynesian are exactly equivalent to the "Elohim" of the old Israelite.[20] They comprise everything spiritual, from a ghost to a god, and from "the merely tutelar gods to particular private families" (vol, ii. p. 104), to Tá-li-y-Tooboó, who was the national god of Tonga. The Tongans had no doubt that these Atuas daily and hourly influenced their destinies and could, conversely, be influenced by them. Hence their "piety," the incessant acts of sacrificial worship which occupied their lives, and their belief in omens and charms. Moreover, the Atuas were believed to visit particular persons,–their own priests in the case of the higher gods, but apparently anybody in that of the lower,–and to inspire them by a process which was conceived to involve the actual residence of the god,

for the [324] time being, in the person inspired, who was thus rendered capable of prophesying (vol. ii. p. 100). For the Tongan, therefore, inspiration indubitably was possession.

When one of the higher gods was invoked, through his priest, by a chief who wished to consult the oracle, or, in old Israelitic phraseology, to "inquire of," the god, a hog was killed and cooked over night, and, together with plantains, yams, and the materials for making the peculiar drink *kava* (of which the Tongans were very fond), was carried next day to the priest. A circle, as for an ordinary kava-drinking entertainment, was then formed; but the priest, as the representative of the god, took the highest place, while the chiefs sat outside the circle, as an expression of humility calculated to please the god.

"As soon as they are all seated the priest is considered as inspired, the god being supposed to exist within him from that moment. He remains for a considerable time in silence with his hands clasped before him, his eyes are cast down and he rests perfectly still. During the time the victuals are being shared out and the kava preparing, the matabooles sometimes begin to consult him; sometimes he answers, and at other times not; in either case he remains with his eyes cast down. Frequently he will not utter a word till the repast is finished and the kava too. When he speaks he generally begins in a low and very altered tone of voice, which gradually rises to nearly its natural pitch, though sometimes a little above it. All that he says is supposed to be the declaration of the god, and he accordingly speaks in the first person, as if he were the god. All this is done generally without any apparent inward emotion or outward agitation; but, on some occasions, his countenance becomes fierce, and as it were inflamed, and his whole frame agitated with inward feeling; he is seized with an [325] universal trembling, the perspiration breaks out on his forehead, and his lips turning black are convulsed; at length tears start in floods from his eyes, his breast heaves with great emotion, and his utterance is choked. These symptoms gradually subside. Before this paroxysm comes on, and after it is over, he often eats as much as four hungry men under other circumstances could devour. The fit being now gone off, he remains for some time calm and then takes up a club that is placed by him for the purpose, turns it over and regards it attentively; he then looks up earnestly, now to the right, now to the left, and now again at the club; afterwards he looks up again and about him in like manner, and then again fixes his eyes on the club, and so on for several times. At length he suddenly raises the club, and, after a moment's pause, strikes the ground or the adjacent part of the house with considerable force, immediately the god leaves him, and he rises up and retires to the back of the ring among the people" (vol. i. pp. 100, 101).

The phenomena thus described, in language which, to any one who is familiar with the manifestations of abnormal mental states among ourselves, bears the stamp of fidelity, furnish a most instructive commentary upon the story of the wise woman of Endor. As in the latter, we have the possession by the spirit or soul (Atua, Elohim), the strange voice, the speaking in the first person. Unfortunately nothing (beyond the loud cry) is mentioned as to the state of the wise woman of Endor. But what we learn from other sources (*e.g.* 1 Sam. x. 20-24) respecting the physical concomitants of inspiration among the old Israelites has its exact equivalent in this and other accounts of Polynesian prophetism. An [326] excellent authority, Moerenhout, who lived among the people of the Society Islands many years and knew them well, says that, in Tahiti, the *rôle* of the prophet had very generally passed out of the hands of the priests into that of private persons who professed to represent the god, often assumed his name, and in this capacity prophesied. I will not run the risk of weakening the force of Moerenhout's description of the prophetic state by translating it:–

"Un individu, dans cet état, avait le bras gauche enveloppé d'un morceau d'étoffe, signe de la presénce de la Divinité. Il ne parlait que d'un ton impérieux et véhément. Ses attaques, quand il allait prophétiser, étaient aussi effroyables qu'imposantes. Il tremblait d'abord de tous ses membres, la figure enflée, les yeux hagards, rouges et étincelants d'une expression sauvage. Il gesticulait, articulait des mots vides de sens, poussait des cris horribles qui faisaient tressaillir tous les assistants, et s'exaltait parfois au point qu'on n'osait par l'approcher. Autour de lui, le silence de la terreur et du respect.... C'est alors qu'il répondait aux questions, annonçait l'avenir, le destin des batailles, la volonte des dieux; et, chose étonnante! au sein de ce délire, de cet enthousiasme religieux, son langage était grave, imposant, son éloquence noble et persuasive."[21]

Just so Saul strips off his clothes, "prophesies" before Samuel, and lies down "naked all that day and night."

Both Mariner and Moerenhout refuse to have recourse to the hypothesis of imposture in order to account for the inspired state of the Polynesian [327] prophets. On the contrary, they fully believe in their sincerity. Mariner tells the story of a young chief, an acquaintance of his, who thought himself possessed by the Atua of a dead woman who had fallen in love with him, and who wished him to die that he might be near her in Bolotoo. And he died accordingly. But the most valuable evidence on this head is contained in what the same authority says about King Finow's son. The previous king, Toogoo Ahoo, had been assassinated by Finow, and his soul, become an Atua of divine rank in Bolotoo, had been pleased to visit and inspire Finow's son–with what particular object does not appear.

"When this young chief returned to Hapai, Mr. Mariner, who was upon a footing of great friendship with him, one day asked him how he felt himself when the spirit of Toogoo Ahoo visited him; he replied that he could not well describe his feelings, but the best he could say of it was, that he felt himself all over in a glow of heat and quite restless and uncomfortable, and did not feel his own personal identity, as it were, but seemed to have a mind different from his own natural mind, his thoughts wandering upon strange and unusual subjects, though perfectly sensible of surrounding objects. He next asked him how he knew it was the spirit of Toogoo Ahoo? His answer was, 'There's a fool! How can I tell you *how* I knew it! I felt and knew it was so by a kind of consciousness; my *mind* told me that it was Toogoo Ahoo" (vol. i. pp. 104, 105).

Finow's son was evidently made for a theological disputant, and fell back at once on the inexpugnable stronghold of faith when other evidence was lacking. "There's a fool! I know it is true, [328] because I know it," is the exemplar and epitome of the sceptic-crushing process in other places than the Tonga Islands.

The island of Bolotoo, to which all the souls (of the upper classes at any rate) repair after the death of the body, and from which they return at will to interfere, for good or evil, with the lives of those whom they have left behind, obviously answers to Sheol. In Tongan tradition, this place of souls is a sort of elysium above ground and pleasant enough to live in. But, in other parts of Polynesia, the corresponding locality, which is called Po, has to be reached by descending into the earth, and is represented dark and gloomy like Sheol. But it was not looked upon as a place of rewards and punishments in any sense. Whether in Bolotoo or in Po, the soul took the rank it had in the flesh; and, a shadow, lived among the shadows of the friends and houses and food of its previous life.

The Tongan theologians recognised several hundred gods; but there was one, already mentioned as their national god, whom they regarded as far greater than any of the others, "as a great chief from the top of the sky down to the bottom of the earth" (Mariner, vol. ii. p. 106). He was also god of war, and the tutelar deity of the royal family, whoever happened to be the incumbent of the royal office for the time being. He had no priest except the king himself, and his visits, even [329] to royalty, were few and far between. The name of this supreme deity was Tá-li-y-Tooboó, the literal meaning of which is said to be "Wait there, Tooboó," from which it would appear that the peculiar characteristic of Tá-li-y-Tooboó, in the eyes of his worshippers, was persistence of duration. And it is curious to notice, in relation to this circumstance, that many Hebrew philologers have thought the meaning of Jahveh to be best expressed by the word "Eternal." It would probably be difficult to express the notion of an eternal being, in a dialect so little fitted to convey abstract conceptions as Tongan, better than by that of one who always "waits there."

The characteristics of the gods in Tongan theology are exactly those of men whose shape they are supposed to possess, only they have more intelligence and greater power. The Tongan belief that, after death, the human Atua more readily distinguishes good from evil, runs parallel with the old Israelitic conception of Elohim expressed in Genesis, "Ye shall be as Elohim, knowing good from evil." They further agreed with the old Israelites, that "all rewards for virtue and punishments for vice happen to men in this world only, and come immediately from the gods" (vol. ii. p. 100). Moreover, they were of opinion that though the gods approve of some kinds of virtue, are displeased with some kinds of vice, and, to a certain extent, protect or forsake [330] their worshippers according to their moral conduct, yet neglect to pay due respect to the deities, and forgetfulness to keep them in good humour, might be visited with even worse consequences than moral delinquency. And those who will carefully study the so-called "Mosaic code" contained in the books of Exodus, Leviticus, and Numbers, will see that, though Jahveh's prohibitions of certain forms of immorality are strict and sweeping, his wrath is quite as strongly kindled against infractions of ritual ordinances. Accidental homicide may go unpunished, and reparation may be made for wilful theft. On the other hand, Nadab and Abihu, who "offered strange fire before Jahveh, which he had not commanded them," were swiftly devoured by Jahveh's fire; he who sacrificed anywhere except at the allotted place was to be "cut off from his people"; so was he who ate blood; and the details of the upholstery of the Tabernacle, of the millinery of the priests' vestments, and of the cabinet work of the ark, can plead direct authority from Jahveh, no less than moral commands.

Amongst the Tongans, the sacrifices were regarded as gifts of food and drink offered to the divine Atuas, just as the articles deposited by the graves of the recently dead were meant as food for Atuas of lower rank. A kava root was a constant form of offering all over Polynesia. In the excellent work of the Rev. George Turner, [331] entitled *Nineteen Years in Polynesia* (p. 241), I find it said of the Samoans (near neighbours of the Tongans):–

"*The offerings* were principally cooked food. As in ancient Greece so in Samoa, the first cup was in honour of the god. It was either poured out on the ground or *waved* towards the heavens, reminding us again of the Mosaic ceremonies. The chiefs all drank a portion out of the same cup, according to rank; and after that, the food brought as an offering was divided and eaten '*there before the Lord.*'"

In Tonga, when they consulted a god who had a priest, the latter, as representative of the god, had the first cup; but if the god, like Tá-li-y-Tooboó, had no priest, then the chief place was left vacant, and was supposed to be occupied by the god himself. When the first cup of kava was filled, the mataboole who acted as master of the ceremonies said, "Give it to your god," and it was offered, though only as a matter of form. In Tonga and Samoa there were many sacred places or *morais*, with houses of the ordinary construction, but which served as temples in consequence of being dedicated to various gods; and there were altars on which the sacrifices were offered; nevertheless there were few or no images. Mariner mentions none in Tonga, and the Samoans seem to have been regarded as no better than atheists by other Polynesians because they had none. It does not appear that either of these peoples had images even of their family or ancestral gods.

[332] In Tahiti and the adjacent islands, Moerenhout (t. i. p. 471) makes the very interesting observation, not only that idols were often absent, but that, where they existed, the images of the gods served merely as depositories for the proper representatives of the divinity. Each of these was called a *maro aurou*, and was a kind of girdle artistically adorned with red, yellow, blue, and black feathers–the red feathers being especially important–which were consecrated and kept as sacred objects within the idols. They were worn by great personages on solemn occasions, and conferred upon their wearers a sacred and almost divine character. There is no distinct evidence that the *maro aurou* was supposed to have any special efficacy in divination, but one cannot fail to see a certain parallelism between this holy girdle, which endowed its wearer with a particular sanctity, and the ephod.

According to the Rev. R. Taylor, the New Zealanders formerly used the word *karakia* (now employed for "prayer") to signify a "spell, charm, or incantation," and the utterance of these karakias constituted the chief part of their cult. In the south, the officiating priest had a small image, "about eighteen inches long, resembling a peg with a carved head," which reminds one of the form commonly attributed to the teraphim.

"The priest first bandaged a fillet of red parrot feathers under the god's chin, which was called his pahau or beard; this [333] bandage was made of a certain kind of sennet, which was tied on in a peculiar way. When this was done it was taken possession of by the Atua, whose spirit entered it. The priest then either held it in the hand and vibrated it in the air whilst the powerful karakia was repeated, or he tied a piece of string (formed of the centre of a flax leaf) round the neck of the image and stuck it in the ground. He sat at a little distance from it, leaning against a tuahu, a short stone pillar stuck in the ground in a slanting position and, holding the string in his hand, he gave the god a jerk to arrest his attention, lest he should be otherwise engaged, like Baal of old, either hunting, fishing, or sleeping, and therefore must be awakened.... The god is supposed to make use of the priest's tongue in giving a reply. Image-worship appears to have been confined to one part of the island. The Atua was supposed only to enter the image for the occasion The natives declare they did not worship the image itself, but only the Atua it represented, and that the image was merely used as a way of approaching him."[22]

This is the excuse for image-worship which the more intelligent idolaters make all the world over; but it is more interesting to observe that, in the present case, we seem to have the equivalents of divination by teraphim, with the aid of something like an ephod (which, however, is used to sanctify the image and not the priest) mixed up together. Many Hebrew archæologists have supposed that the term "ephod" is

sometimes used for an image (particularly in the case of Gideon's ephod), and the story of Micah, in the book of Judges, shows that images were, at any rate, employed in close association with the ephod. If the pulling of the [334] string to call the attention of the god seems as absurd to us as it appears to have done to the worthy missionary, who tells us of the practice, it should be recollected that the high priest of Jahveh was ordered to wear a garment fringed with golden bells.

"And it shall be upon Aaron to minister; and the sound thereof shall be heard when he goeth in unto the holy place before Jahveh, and when he cometh out, that he die not" (Exod. xxviii. 35).

An escape from the obvious conclusion suggested by this passage has been sought in the supposition that these bells rang for the sake of the worshippers, as at the elevation of the host in the Roman Catholic ritual; but then why should the priest be threatened with the well-known penalty for inadvisedly beholding the divinity?

In truth, the intermediate step between the Maori practice and that of the old Israelites is furnished by the Kami temples in Japan. These are provided with bells which the worshippers who present themselves ring, in order to call the attention of the ancestor-god to their presence. Grant the fundamental assumption of the essentially human character of the spirit, whether Atua, Kami, or Elohim, and all these practices are equally rational.

The sacrifices to the gods in Tonga, and elsewhere in Polynesia, were ordinarily social gatherings, in which the god, either in his own person or in that of his priestly representative, was supposed to take part. These sacrifices were offered on every occasion of importance, and even the daily meals were prefaced by oblations and libations of food and drink, exactly answering to those offered by the old Romans to their manes, penates, and lares. The sacrifices had no moral significance, but were the necessary result of the theory that the god was either a deified ghost of an ancestor or chief, or, at any rate, a being of like nature to these. If one wanted to get anything out of him, therefore, the first step was to put him in good humour by gifts; and if one desired to escape his wrath, which might be excited by the most trifling neglect or unintentional disrespect, the great thing was to pacify him by costly presents. King Finow appears to have been somewhat of a freethinker (to the great horror of his subjects), and it was only his untimely death which prevented him from dealing with the priest of a god, who had not returned a favourable answer to his supplications, as Saul dealt with the priests of the sanctuary of Jahveh at Nob. Nevertheless, Finow showed his practical belief in the gods during the sickness of a daughter, to whom he was fondly attached, in a fashion which has a close parallel in the history of Israel.

"If the gods have any resentment against us, let the whole weight of vengeance fall on my head. I fear not their vengeance–but spare my child; and I earnestly entreat you, Toobo Totái [336] [the god whom he had evoked], to exert all your influence with the other gods that I alone may suffer all the punishment they desire to inflict" (vol. i. p. 354).

So when the king of Israel has sinned by "numbering the people," and they are punished for his fault by a pestilence which slays seventy thousand innocent men, David cries to Jahveh:–

"Lo, I have sinned, and I have done perversely; but these sheep, what have they done? let thine hand, I pray thee, be against me, and against my father's house" (2 Sam. xxiv. 17).

Human sacrifices were extremely common in Polynesia; and, in Tonga, the "devotion" of a child by strangling was a favourite method of averting the wrath of the gods. The well-known instances of Jephthah's sacrifice of his daughter and of David's giving up the seven sons of Saul to be sacrificed by the Gibeonites "before Jahveh," appear to me to leave no doubt that the old Israelites, even when devout worshippers of Jahveh, considered human sacrifices, under certain circumstances, to be not only permissible but laudable. Samuel's hewing to pieces of the miserable captive, sole survivor of his nation, Agag, "before Jahveh," can hardly be viewed in any other light. The life of Moses is redeemed from Jahveh, who "sought to slay him," by Zipporah's symbolical sacrifice of her child, by the bloody operation of circumcision. Jahveh expressly affirms that the first-born males of men and beasts [337] are devoted to him; in accordance with that claim, the first-born males of the beasts are duly sacrificed; and it is only by special permission that the claim to the first-born of men is waived, and it is enacted that they may be redeemed (Exod. xiii. 12-15). Is it possible to avoid the conclusion that immolation of their first-born sons would have been incumbent on the worshippers of Jahveh, had they not been thus specially excused? Can any other conclusion be drawn from the history of Abraham and Isaac? Does Abraham exhibit any indication of surprise when he receives the astounding order to sacrifice his son? Is there the slightest evidence that there was anything in his intimate and personal acquaintance with the character of the Deity, who had eaten the meat and drunk the milk which Abraham set before him under the oaks of Mamre, to lead him to hesitate–even to wait twelve or fourteen hours for a repetition of the command? Not a whit. We are told that "Abraham rose early in the morning" and led his only child to the slaughter, as if it were the most ordinary business imaginable. Whether the story has any historical foundation or not, it is valuable as showing that the writer of it conceived Jahveh as a deity whose requirement of such a sacrifice need excite neither astonishment nor suspicion of mistake on the part of his devotee. Hence, when the incessant human sacrifices in Israel, during the age of the kings, are put down [338] to the influence of foreign idolatries, we may fairly inquire whether editorial Bowdlerising has not prevailed over historical truth.

An attempt to compare the ethical standards of two nations, one of which has a written code, while the other has not, is beset with difficulties. With all that is strange and, in many cases, repulsive to us in the social arrangements and opinions respecting moral obligation among the Tongans, as they are placed before us, with perfect candour, in Mariner's account, there is much that indicates a strong ethical sense. They showed great kindliness to one another, and faithfulness in standing by their comrades in war. No people could have better observed either the third or the fifth commandment; for they had a particular horror of blasphemy, and their respectful tenderness towards their parents and, indeed, towards old people in general, was remarkable.

It cannot be said that the eighth commandment was generally observed, especially where Europeans were concerned; nevertheless a well-bred Tongan looked upon theft as a meanness to which he would not condescend. As to the seventh commandment, any breach of it was considered scandalous in women and as something to be avoided in self-respecting men; but, among unmarried and widowed people, chastity was held very cheap. Nevertheless the women were extremely well treated, and often showed

them[339]selves capable of great devotion and entire faithfulness. In the matter of cruelty, treachery, and bloodthirstiness, these islanders were neither better nor worse than most peoples of antiquity. It is to the credit of the Tongans that they particularly objected to slander; nor can covetousness be regarded as their characteristic; for Mariner says:–

"When any one is about to eat, he always shares out what he has to those about him, without any hesitation, and a contrary conduct would be considered exceedingly vile and selfish" (vol. ii p. 145).

In fact, they thought very badly of the English when Mariner told them that his countrymen did not act exactly on that principle. It further appears that they decidedly belonged to the school of intuitive moral philosophers, and believed that virtue is its own reward; for

"Many of the chiefs, on being asked by Mr. Mariner what motives they had for conducting themselves with propriety, besides the fear of misfortunes in this life, replied, the agreeable and happy feeling which a man experiences within himself when he does any good action or conducts himself nobly and generously as a man ought to do; and this question they answered as if they wondered such a question should be asked" (vol. ii. p. 161).

One may read from the beginning of the book of Judges to the end of the books of Samuel without discovering that the old Israelites had a moral standard which differs, in any essential respect [340] (except perhaps in regard to the chastity of unmarried women), from that of the Tongans. Gideon, Jephthah, Samson, and David are strong-handed men, some of whom are not outdone by any Polynesian chieftain in the matter of murder and treachery; while Deborah's jubilation over Jael's violation of the primary duty of hospitality, proffered and accepted under circumstances which give a peculiarly atrocious character to the murder of the guest; and her witch-like gloating over the picture of the disappointment of the mother of the victim–

> The mother of Sisera cried through the lattice,
> Why is his chariot so long in coming? (Jud. v. 28.)

–would not have been out of place in the choral service of the most sanguinary god in the Polynesian pantheon.

With respect to the cannibalism which the Tongans occasionally practised, Mariner says:–

"Although a few young ferocious warriors chose to imitate what they considered a mark of courageous fierceness in a neighbouring nation, it was held in disgust by everybody else" (vol. ii. p. 171).

That the moral standard of Tongan life was less elevated than that indicated in the "Book of the Covenant" (Exod. xxi.-xxiii.) may be freely admitted. But then the evidence that this Book of the Covenant, and even the ten commandments as given in Exodus, were known to the Israelites [341] of the time of Samuel and Saul, is (to say the least) by no means conclusive. The Deuteronomic version of the fourth commandment is hopelessly discrepant from that which stands in Exodus. Would any later writer

have ventured to alter the commandments as given from Sinai, if he had had before him that which professed to be an accurate statement of the "ten words" in Exodus? And if the writer of Deuteronomy had not Exodus before him, what is the value of the claim of the version of the ten commandments therein contained to authenticity? From one end to the other of the books of Judges and Samuel, the only "commandments of Jahveh" which are specially adduced refer to the prohibition of the worship of other gods, or are orders given *ad hoc*, and have nothing to do with questions of morality.

In Polynesia, the belief in witchcraft, in the appearance of spiritual beings in dreams, in possession as the cause of diseases, and in omens, prevailed universally. Mariner tells a story of a woman of rank who was greatly attached to King Finow, and who, for the space of six months after his death, scarcely ever slept elsewhere than on his grave, which she kept carefully decorated with flowers:–

"One day she went, with the deepest affliction, to the house of Mo-oonga Toobó, the widow of the deceased chief, to communicate what had happened to her at the *fytoca* [grave] during several nights, and which caused her the greatest anxiety. [342] She related that she had dreamed that the late How [King] appeared to her and, with a countenance full of disappointment, asked why there yet remained at Vavaoo so many evil-designing persons; for he declared that, since he had been at Bolotoo, his spirit had been disturbed[22] by the evil machinations of wicked men conspiring against his son; but he declared that "the youth" should not be molested nor his power shaken by the spirit of rebellion; that he therefore came to her with a warning voice to prevent such disastrous consequences" (vol. i. p. 424).

On inquiry it turned out that the charm of *tattao* had been performed on Finow's grave, with the view of injuring his son, the reigning king, and it is to be presumed that it was this sorcerer's work which had "disturbed" Finow's spirit. The Rev. Richard Taylor says in the work already cited: "The account given of the witch of Endor agrees most remarkably with the witches of New Zealand" (p. 45).

The Tongans also believed in a mode of divination (essentially similar to the casting of lots) the twirling of a cocoanut.

"The object of inquiry . . . is chiefly whether a sick person will recover; for this purpose the nut being placed on the ground, a relation of the sick person determines that, if the nut, when again at rest, points to such a quarter, the east for example, that the sick man will recover; he then prays aloud to the patron god of the family that he will be pleased to direct the nut so that it may indicate the truth; the nut being next spun, the result is attended to with confidence, at least with a full conviction that it will truly declare the intentions of the gods at the time" (vol. ii. p. 227).

[343] Does not the action of Saul, on a famous occasion, involve exactly the same theological presuppositions?

"Therefore Saul said unto Jahveh, the Elohim of Israel, Shew the right. And Jonathan and Saul were taken by lot: but the people escaped. And Saul said, Cast *lots* between me and Jonathan my son. And Jonathan was taken. And Saul said to Jonathan, Tell me what thou hast done.... And the people rescued Jonathan so that he died not "(1 Sam. xiv. 41-45).

As the Israelites had great yearly feasts, so had the Polynesians; as the Israelites practised circumcision, so did many Polynesian people; as the Israelites had a complex and often arbitrary-seeming multitude of distinctions between clean and unclean things, and clean and unclean states of men, to which they attached great importance, so had the Polynesians their notions of ceremonial purity and their *tabu*, an equally extensive and strange system of prohibitions, violation of which was visited by death. These doctrines of cleanness and uncleanness no doubt may have taken their rise in the real or fancied utility of the prescriptions, but it is probable that the origin of many is indicated in the curious habit of the Samoans to make fetishes of living animals. It will be recollected that these people had no "gods made with hands," but they substituted animals for them.

At his birth

"every Samoan was supposed to be taken under the care of some tutelary god or *aitu* [= Atua] as it was called. The help of [344] perhaps half a dozen different gods was invoked in succession on the occasion, but the one who happened to be addressed just as the child was born was marked and declared to be the child's god for life.

These gods were supposed to appear in some *visible incarnation,* and the particular thing in which his god was in the habit of appearing was, to the Samoan, an object of veneration. It was in fact his idol, and he was careful never to injure it or treat it with contempt. One, for instance, saw his god in the eel, another in the shark, another in the turtle, another in the dog, another in the owl, another in the lizard; and so on, throughout all the fish of the sea and birds and four-footed beasts and creeping things. In some of the shell-fish even, gods were supposed to be present. A man would eat freely of what was regarded as the incarnation of the god of another man, but the incarnation of his own particular god he would consider it death to injure or eat."[23]

We have here that which appears to be the origin, or one of the origins, of food prohibitions, on the one hand, and of totemism on the other. When it is remembered that the old Israelites sprang from ancestors who are said to have resided near, or in, one of the great seats of ancient Babylonian civilisation, the city of Ur; that they had been, it is said for centuries, in close contact with the Egyptians; and that, in the theology of both the Babylonians and the Egyptians, there is abundant evidence, notwithstanding their advanced social organisation, of the belief in spirits, with sorcery, ancestor-worship, the deification of animals, and the converse animalisation of gods–it obviously needs very strong evidence to justify the [345] belief that the rude tribes of Israel did not share the notions from which their far more civilised neighbours had not emancipated themselves.

But it is surely needless to carry the comparison further. Out of the abundant evidence at command, I think that sufficient has been produced to furnish ample grounds for the belief, that the old Israelites of the time of Samuel entertained theological conceptions which were on a level with those current among the more civilised of the Polynesian islanders, though their ethical code may possibly, in some respects, have been more advanced.[24]

A theological system of essentially similar character, exhibiting the same fundamental conceptions respecting the continued existence and incessant interference in human affairs of disembodied spirits,

prevails, or formerly prevailed, among the whole of the inhabitants of the Polynesian and Melanesian islands, and among the people of Australia, notwithstanding the wide differences in physical character and in grade of civilisation which obtain among them. And the same proposition is true of the people who inhabit the riverain shores of the Pacific Ocean whether Dyaks, Malays, Indo-Chinese, Chinese, Japanese, the wild tribes of America, or the highly civilised old Mexicans and Peruvians. It is no less true of the Mongolic [346] nomads of Northern Asia, of the Asiatic Aryans and of the Ancient Greeks and Romans, and it holds good among the Dravidians of the Dekhan and the negro tribes of Africa. No tribe of savages which has yet been discovered, has been conclusively proved to have so poor a theological equipment as to be devoid of a belief in ghosts, and in the utility of some form of witchcraft, in influencing those ghosts. And there is no nation, modern or ancient, which, even at this moment, has wholly given up the belief; and in which it has not, at one time or other, played a great part in practical life.

This *sciotheism*,[25] as it might be called, is found, in several degrees of complexity, in rough correspondence with the stages of social organisation, and, like these, separated by no sudden breaks.

In its simplest condition, such as may be met with among the Australian savages, theology is a mere belief in the existence, powers, and disposition (usually malignant) of ghostlike entities who may be propitiated or scared away; but no cult can properly be said to exist. And, in this stage, theology is wholly independent of ethics. The moral code, such as is implied by public opinion, derives no sanction from the theological dogmas, [347] and the influence of the spirits is supposed to be exerted out of mere caprice or malice.

As a next stage, the fundamental fear of ghosts and the consequent desire to propitiate them acquire an organised ritual in simple forms of ancestor-worship, such as the Rev. Mr. Turner describes among the people of Tanna (*l.c.* p. 88); and this line of development may be followed out until it attains its acme in the State-theology of China and the Kami-theology[26] of Japan. Each of these is essentially ancestor-worship, the ancestors being reckoned back through family groups, of higher and higher order, sometimes with strict reference to the principle of agnation, as in old Rome; and, as in the latter, it is intimately bound up with the whole organisation of the State. There are no idols; inscribed tablets in China, and strips of paper lodged in a peculiar portable shrine in Japan, represent the souls of the deceased, or the special seats which they occupy when sacrifices are offered by their descendants. In Japan it is interesting to observe that a national Kami–Ten-zio-dai-zin–is worshipped as a sort of Jahveh by the nation in general, and (as Lippert has observed) it is singular that his special seat is a portable litter-like shrine, termed the Mikosi, in some sort analogous to the Israelitic ark. In China, the emperor [348] is the representative of the primitive ancestors, and stands, as it were, between them and the supreme cosmic deities–Heaven and Earth–who are superadded to them, and who answer to the Tangaloa and the Maui of the Polynesians.

Sciotheism, under the form of the deification of ancestral ghosts, in its most pronounced form, is therefore the chief element in the theology of a great moiety, possibly of more than half, of the human race. I think this must be taken to be a matter of fact–though various opinions may be held as to how this

ancestor-worship came about. But on the other hand, it is no less a matter of fact that there are very few people without additional gods, who cannot, with certainty, be accounted for as deified ancestors.

With all respect for the distinguished authorities on the other side, I cannot find good reasons for accepting the theory that the cosmic deities–who are superadded to deified ancestors even in China; who are found all over Polynesia, in Tangaloa and Maui, and in old Peru, in the Sun–are the product either of the "search after the infinite," or of mistakes arising out of the confusion of a great chief's name with the thing signified by the name. But, however this may be, I think it is again merely matter of fact that, among a large portion of mankind, ancestor-worship is more or less thrown into the background either by such cosmic deities, or by tribal gods of uncertain [349] origin, who have been raised to eminence by the superiority in warfare, or otherwise, of their worshippers.

Among certain nations, the polytheistic theology, thus constituted, has become modified by the selection of some one cosmic or tribal god, as the only god to whom worship is due on the part of that nation (though it is by no means denied that other nations have a right to worship other gods), and thus results a worship of one God–*monolatry*, as Wellhausen calls it–which is very different from genuine monotheism.[27] In ancestral sciotheism, and in this *monolatry*, the ethical code, often of a very high order, comes into closer relation with the theological creed. Morality is taken under the patronage of the god or gods, who reward all morally good conduct and punish all morally evil conduct in this world or the next. At the same time, however, they are conceived to be thoroughly human, and they visit any shadow of disrespect to themselves, shown by disobedience to their commands, or by delay, or carelessness, in carrying them out, as severely as any breach of the moral laws. Piety means minute attention to the due performance of all sacred rites, and covers any number of lapses in morality, just as cruelty, treachery, murder, and adultery did not bar David's claim to the title of the man after God's own [350] heart among the Israelites; crimes against men may be expiated, but blasphemy against the gods is an unpardonable sin. Men forgive all injuries but those which touch their self-esteem; and they make their gods after their own likeness, in their own image make they them.

It is in the category of monolatry that I conceive the theology of the old Israelites must be ranged. They were polytheists, in so far as they admitted the existence of other Elohim of divine rank beside Jahveh; they differed from ordinary polytheists, in so far as they believed that Jahveh was the supreme god and the one proper object of their own national worship. But it will doubtless be objected that I have been building up a fictitious Israelitic theology on the foundation of the recorded habits and customs of the people, when they had lapsed from the ordinances of their great lawgiver and prophet Moses, and that my conclusions may be good for the perverts to Canaanitish theology, but not for the true observers of the Sinaitic legislation. The answer to the objection is that–so far as I can form a judgment of that which is well ascertained in the history of Israel–there is very little ground for believing that we know much, either about the theological and social value of the influence of Moses, or about what happened during the wanderings in the Desert.

[351] The account of the Exodus and of the occurrences in the Sinaitic peninsula; in fact, all the history of Israel before the invasion of Canaan, is full of wonderful stories, which may be true, in so far as they

are conceivable occurrences, but which are certainly not probable, and which I, for one, decline to accept until evidence, which deserves that name, is offered of their historical truth. Up to this time I know of none.[28] Furthermore, I see no answer to the argument that one has no right to pick out of an obviously unhistorical statement the assertions which happen to be probable and to discard the rest. But it is also certain that a primitively veracious tradition may be smothered under subsequent mythical additions, and that one has no right to cast away the former along with the latter. Thus, perhaps the fairest way of stating the case may be as follows.

There can be no *a priori* objection to the supposition that the Israelites were delivered from their Egyptian bondage by a leader called Moses, and that he exerted a great influence over their subsequent organisation in the Desert. There is no reason to doubt that, during their residence in the land of Goshen, the Israelites knew nothing of Jahveh; but, as their own prophets declare (see Ezek. xx.), were polytheistic idolaters, sharing in [352] the worst practices of their neighbours. As to their conduct in other respects, nothing is known. But it may fairly be suspected that their ethics were not of a higher order than those of Jacob, their progenitor, in which case they might derive great profit from contact with Egyptian society, which held honesty and truthfulness in the highest esteem. Thanks to the Egyptologers, we now know, with all requisite certainty, the moral standard of that society in the time, and long before the time, of Moses. It can be determined from the scrolls buried with the mummified dead and from the inscriptions on the tombs and memorial statues of that age. For, though the lying of epitaphs is proverbial, so far as their subject is concerned, they gave an unmistakable insight into that which the writers and the readers of them think praiseworthy.

In the famous tombs at Beni Hassan there is a record of the life of Prince Nakht, who served Osertasen II., a Pharaoh of the twelfth dynasty as governor of a province. The inscription speaks in his name: "I was a benevolent and kindly governor who loved his country.... Never was a little child distressed nor a widow ill-treated by me. I have never repelled a workman nor hindered a shepherd. I gave alike to the widow and to the married woman, and have not preferred the great to the small in my gifts." And we have the high authority of the late Dr. Samuel Birch for [353] the statement that the inscriptions of the twelfth dynasty abound in injunctions of a high ethical character. "To feed the hungry, give drink to the thirsty, clothe the naked, bury the dead, loyally serve the king, formed the first duty of a pious man and faithful subject."[29] The people for whom these inscriptions embodied their ideal of praiseworthiness assuredly had no imperfect conception of either justice or mercy. But there is a document which gives still better evidence of the moral standard of the Egyptians. It is the "Book of the Dead," a sort of "Guide to Spiritland," the whole, or a part, of which was buried with the mummy of every well-to-do Egyptian, while extracts from it are found in innumerable inscriptions. Portions of this work are of extreme antiquity, evidence of their existence occurring as far back as the fifth and sixth dynasties; while the 120th chapter, which constitutes a sort of book by itself, and is known as the "Book of Redemption in the Hall of the two Truths," is frequently inscribed upon coffins and other monuments of the nineteenth dynasty (that under which, there is some reason to believe, the Israelites were oppressed and the Exodus took place), and it occurs, more than once, in the famous tombs of the kings of this and the preceding dynasty at Thebes.[30] This [354] "Book of Redemption" is chiefly occupied by the so-called "negative confession" made to the forty-two Divine Judges, in which the soul of the dead denies that he has

committed faults of various kinds. It is, therefore, obvious that the Egyptians conceived that their gods commanded them not to do the deeds which are here denied. The "Book of Redemption," in fact, implies the existence in the mind of the Egyptians, if not in a formal writing, of a series of ordinances, couched, like the majority of the ten commandments, in negative terms. And it is easy to prove the implied existence of a series which nearly answers to the "ten words." Of course a polytheistic and image-worshipping people, who observed a great many holy days, but no Sabbaths, could have nothing analogous to the first or the second and the fourth commandments of the Decalogue; but answering to the third, is "I have not blasphemed;" to the fifth, "I have not reviled the face of the king or my father;" to the sixth, "I have not murdered;" to the seventh, "I have not committed adultery;" to the eighth, "I have not stolen," "I have not done fraud to man;" to the ninth, "I have not told falsehoods in the tribunal of truth," and, further, "I have not calumniated the slave to his master." I find nothing exactly similar to the tenth commandment; but that the inward disposition of mind was held to be of no less importance than the outward act is to be gathered from the [355] praises of kindliness already cited and the cry of "I am pure," which is repeated by the soul on trial. Moreover, there is a minuteness of detail in the confession which shows no little delicacy of moral appreciation–"I have not privily done evil against mankind," "I have not afflicted men," "I have not withheld milk from the mouths of sucklings," "I have not been idle," "I have not played the hypocrite," "I have not told falsehoods," "I have not corrupted woman or man," "I have not caused fear," "I have not multiplied words in speaking."

Would that the moral sense of the nineteenth century A.D. were as far advanced as that of the Egyptians in the nineteenth century B.C. in this last particular! What incalculable benefit to mankind would flow from strict observance of the commandment, "Thou shalt not multiply words in speaking!" Nothing is more remarkable than the stress which the old Egyptians, here and elsewhere, lay upon this and other kinds of truthfulness, as compared with the absence of any such requirement in the Israelitic Decalogue, in which only a specific kind of untruthfulnes is forbidden.

If, as the story runs, Moses was adopted by a princess of the royal house, and was instructed in all the wisdom of the Egyptians, it is surely incredible that he should not have been familiar from his youth up, with the high moral code implied in the "Book of Redemption." It is [356] surely impossible that he should have been less familiar with the complete legal system, and with the method of administration of justice, which, even in his time, had enabled the Egyptian people to hold together, as a complex social organisation, for a period far longer than the duration of old Roman society, from the building of the city to the death of the last Cæsar. Nor need we look to Moses alone for the influence of Egypt upon Israel. It is true that the Hebrew nomads who came into contact with the Egyptians of Osertasen, or of Ramses, stood in much the same relation to them, in point of culture, as a Germanic tribe did to the Romans of Tiberius, or of Marcus Antoninus; or as Captain Cook's Omai did to the English of George the Third. But, at the same time, any difficulty of communication which might have arisen out of this circumstance was removed by the long pre-existing intercourse of other Semites, of every grade of civilisation, with the Egyptians. In Mesopotamia and elsewhere, as in Phœnicia, Semitic people had attained to a social organisation as advanced as that of the Egyptians; Semites had conquered and occupied Lower Egypt for centuries. So extensively had Semitic influences penetrated Egypt that the Egyptian language, during the period of the nineteenth dynasty, is said by Brugsch to be as full of Semitisms as German is of Gallicisms; while Semitic deities had supplanted the Egyptian gods at Heliopolis and else[357]where.

On the other hand, the Semites, as far as Phœnicia, were extensively influenced by Egypt.

It is generally admitted[31] that Moses, Phinehas (and perhaps Aaron), are names of Egyptian origin, and there is excellent authority for the statement that the name *Abir,* which the Israelites gave to their golden calf, and which is also used to signify the strong, the heavenly, and even God,[32] is simply the Egyptian Apis. Brugsch points out that the god, Tum or Tom, who was the special object of worship in the city of Pi-Tom, with which the Israelites were only too familiar, was called Ankh and the "great god," and had no image. Ankh means "He who lives," "the living one," a name the resemblance of which to the "I am that I am" of Exodus is unmistakable, whatever may be the value of the fact. Every discussion of Israelitic ritual seeks and finds the explanation of its details in the portable sacred chests, the altars, the priestly dress, the breastplate, the incense, and the sacrifices depicted on the monuments of Egypt. But it must be remembered that these signs of the influence of Egypt upon Israel are not necessarily evidence that such influence was exerted before the Exodus. It may have come much later, through the close connection of the [358] Israel of David and Solomon, first with Phœnicia and then with Egypt.

If we suppose Moses to have been a man of the stamp of Calvin, there is no difficulty in conceiving that he may have constructed the substance of the ten words, and even of the Book of the Covenant, which curiously resembles parts of the Book of the Dead, from the foundation of Egyptian ethics and theology which had filtered through to the Israelites in general, or had been furnished specially to himself by his early education; just as the great Genevese reformer built up a puritanic social organisation on so much as remained of the ethics and theology of the Roman Church, after he had trimmed them to his liking.

Thus, I repeat, I see no *a priori* objection to the assumption that Moses may have endeavoured to give his people a theologico-political organisation based on the ten commandments (though certainly not quite in their present form) and the Book of the Covenant, contained in our present book of Exodus. But whether there is such evidence as amounts to proof, or, I had better say, to probability, that even this much of the Pentateuch owes its origin to Moses is another matter. The mythical character of the accessories of the Sinaitic history is patent, and it would take a good deal more evidence than is afforded by the bare assertion of an unknown writer to justify the [359] belief that the people who "saw the thunderings and the lightnings and the voice of the trumpet and the mountain smoking" (Exod. xx. 18); to whom Jahveh orders Moses to say, "Ye yourselves have seen that I have talked with you from heaven. Ye shall not make other gods with me; gods of silver and gods of gold ye shall not make unto you" (*ibid.* 22, 23), should, less than six weeks afterwards, have done the exact thing they were thus awfully forbidden to do. Nor is the credibility of the story increased by the statement that Aaron, the brother of Moses, the witness and fellow-worker of the miracles before Pharaoh, was their leader and the artificer of the idol. And yet, at the same time, Aaron was apparently so ignorant of wrongdoing that he made proclamation, "Tomorrow shall be a feast to Jahveh," and the people proceeded to offer their burnt-offerings and peace-offerings, as if everything in their proceedings must be satisfactory to the Deity with whom they had just made a solemn covenant to abolish image-worship. It seems to me that, on a survey of all the facts of the case, only a very cautious and hypothetical judgment is justifiable. It may be that Moses profited by the opportunities afforded him of access to what was best in Egyptian society to become acquainted, not only with its advanced ethical and legal code, but with the more or less

pantheistic unification of the Divine to which the speculations of the Egyptian [360] thinkers, like those of all polytheistic philosophers, from Polynesia to Greece, tend; if indeed the theology of the period of the nineteenth dynasty was not, as some Egyptologists think, a modification of an earlier, more distinctly monotheistic doctrine of a long antecedent age. It took only half a dozen centuries for the theology of Paul to become the theology of Gregory the Great; and it is possible that twenty centuries lay between the theology of the first worshippers in the sanctuary of the Sphinx and that of the priests of Ramses Maimun.

It may be that the ten commandments and the Book of the Covenant are based upon faithful traditions of the efforts of a great leader to raise his followers to his own level. For myself, as a matter of pious opinion, I like to think so; as I like to imagine that, between Moses and Samuel, there may have been many a seer, many a herdsman such as him of Tekoah, lonely amidst the hills of Ephraim and Judah, who cherished and kept alive these traditions. In the present results of Biblical criticism, however, I can discover no justification for the common assumption that, between the time of Joshua and that of Rehoboam, the Israelites were familiar with either the Deuteronomic or the Levitical legislation; or that the theology of the Israelites, from the king who sat on the throne to the lowest of his subjects, was in any important respect different from that which [361] might naturally be expected from their previous history and the conditions of their existence. But there is excellent evidence to the contrary effect. And, for my part, I see no reason to doubt that, like the rest of the world, the Israelites had passed through a period of mere ghost-worship, and had advanced through Ancestor-worship and Fetishism and Totemism to the theological level at which we find them in the books of Judges and Samuel.

All the more remarkable, therefore, is the extraordinary change which is to be noted in the eighth century B.C. The student who is familiar with the theology implied, or expressed, in the books of Judges, Samuel, and the first book of Kings, finds himself in a new world of thought, in the full tide of a great reformation, when he reads Joel, Amos, Hosea, Isaiah, Micah, and Jeremiah.

The essence of this change is the reversal of the position which, in primitive society, ethics holds in relation to theology. Originally, that which men worship is a theological hypothesis, not a moral ideal. The prophets, in substance, if not always in form preach the opposite doctrine. They are constantly striving to free the moral ideal from the stifling embrace of the current theology and its concomitant ritual. Theirs was not an intellectual criticism, argued on strictly scientific grounds; the image-worshippers and the believers in the efficacy [361] of sacrifices and ceremonies might logically have held their own against anything the prophets have to say; it was an ethical criticism. From the height of his moral intuition–that the whole duty of man is to do justice and to love mercy and to bear himself as humbly as befits his insignificance in face of the Infinite–the prophet simply laughs at the idolaters of stocks and stones and the idolaters of ritual. Idols of the first kind, in his experience, were inseparably united with the practice of immorality, and they were to be ruthlessly destroyed. As for sacrifices and ceremonies, whatever their intrinsic value might be, they might be tolerated on condition of ceasing to be idols; they might even be praiseworthy on condition of being made to subserve the worship of the true Jahveh–the moral ideal.

If the realm of David had remained undivided, if the Assyrian and the Chaldean and the Egyptian had

left Israel to the ordinary course of development of an Oriental kingdom, it is possible that the effects of the reforming zeal of the prophets of the eighth and seventh centuries might have been effaced by the growth, according to its inevitable tendencies, of the theology which they combated. But the captivity made the fortune of the ideas which it was the privilege of these men to launch upon an endless career. With the abolition of the Temple-services for more than half a century, the priest must have lost and the scribe [363] gained influence. The puritanism of a vigorous minority among the Babylonian Jews rooted out polytheism from all its hiding-places in the theology which they had inherited; they created the first consistent, remorseless, naked monotheism, which, so far as history records, appeared in the world (for Zoroastrism is practically ditheism, and Buddhism any-theism or no-theism); and they inseparably united therewith an ethical code, which, for its purity and for its efficiency as a bond of social life, was and is, unsurpassed. So I think we must not judge Ezra and Nehemiah and their followers too hardly, if they exemplified the usual doom of poor humanity to escape from one error only to fall into another; if they failed to free themselves as completely from the idolatry of ritual as they had from that of images and dogmas; if they cherished the new fetters of the Levitical legislation which they had fitted upon themselves and their nation, as though such bonds had the sanctity of the obligations of morality; and if they led succeeding generations to spend their best energies in building that "hedge round the Torah" which was meant to preserve both ethics and theology, but which too often had the effect of pampering the latter and starving the former. The world being what it was, it is to be doubted whether Israel would have preserved intact the pure ore of religion, which the prophets had extracted for the use of mankind as well as for [364] their nation, had not the leaders of the nation been zealous, even to death, for the dross of the law in which it was embedded. The struggle of the Jews, under the Maccabean house, against the Seleucidæ was as important for mankind as that of the Greeks against the Persians. And, of all the strange ironies of history, perhaps the strangest is that "Pharisee" is current, as a term of reproach, among the theological descendants of that sect of Nazarenes who, without the martyr spirit of those primitive Puritans, would never have come into existence. They, like their historical successors, our own Puritans, have shared the general fate of the poor wise men who save cities.

A criticism of theology from the side of science is not thought of by the prophets, and is at most indicated in the books of Job and Ecclesiastes, in both of which the problem of vindicating the ways of God to man is given up, though on different grounds, as a hopeless one. But with the extensive introduction of Greek thought among the Jews, which took place, not only during the domination of the Seleucidæ in Palestine, but in the great Judaic colony which flourished in Egypt under the Ptolemies, criticism, on both ethical and scientific grounds, took a new departure.

In the hands of the Alexandrian Jews, as represented by Philo, the fundamental axiom of later Jewish, as of Christian monotheism, that the Deity [365] is infinitely perfect and infinitely good, worked itself out into its logical consequence–agnostic theism. Philo will allow of no point of contact between God and a world in which evil exists. For him God has no relation to space or to time, and, as infinite, suffers no predicate beyond that of existence. It is therefore absurd to ascribe to Him mental faculties and affections comparable in the remotest degree to those of men; He is in no way an object of cognition; He is [...] without quality and incomprehensible.[33] That is to say the Alexandrian Jew of the first century had anticipated the reasonings of Hamilton and Mansell in the nineteenth, and, for him, God is the

Unknowable in the sense in which that term is used by Mr. Herbert Spencer. Moreover, Philo's definition of the Supreme Being would not be inconsistent with that "substantia constans infinitis attributis, quorum unumquodque æternam et infinitam essentiam exprimit," given by another great Israelite, were it not that Spinoza's doctrine of the immanence of the Deity in the world puts him, at any rate formally, at the antipodes of theological speculation. But the conception of the essential incognoscibility of the Deity is the same in each case. However, Philo [366] was too thorough an Israelite and too much the child of his time to be content with this agnostic position. With the help of the Platonic and Stoic philosophy, he constructed an apprehensible, if not comprehensible, quasi-deity out of the Logos; while other more or less personified divine powers, or attributes, bridged over the interval between God and man; between the sacred existence, too pure to be called by any name which implied a conceivable quality, and the gross and evil world of matter. In order to get over the ethical difficulties presented by the naive naturalism of many parts of those Scriptures, in the divine authority of which he firmly believed, Philo borrowed from the Stoics (who had been in like straits in respect of Greek mythology), that great Excalibur which they had forged with infinite pains and skill–the method of allegorical interpretation. This mighty "two-handed engine at the door" of the theologian is warranted to make a speedy end of any and every moral or intellectual difficulty, by showing that, taken allegorically or, as it is otherwise said, "poetically" or, "in a spiritual sense," the plainest words mean whatever a pious interpreter desires they should mean. In Biblical phrase, Zeno (who probably had a strain of Semitic blood in him) was the "father of all such as reconcile." No doubt Philo and his followers were eminently religious men; but they did endless injury to the cause of religion [367] by laying the foundations of a new theology, while equipping the defenders of it with the subtlest of all weapons of offence and defence, and with an inexhaustible store of sophistical arguments of the most plausible aspect.

The question of the real bearing upon theology of the influence exerted by the teaching of Philo's contemporary, Jesus of Nazareth, is one upon which it is not germane to my present purpose to enter. I take it simply as an unquestionable fact that his immediate disciples, known to their countrymen as "Nazarenes," were regarded as, and considered themselves to be, perfectly orthodox Jews, belonging to the puritanic or pharisaic section of their people, and differing from the rest only in their belief that the Messiah had already come. Christianity, it is said, first became clearly differentiated at Antioch, and it separated itself from orthodox Judaism by denying the obligation of the rite of circumcision and of the food prohibitions, prescribed by the law. Henceforward theology became relatively stationary among the Jews,[34] and the history of its rapid progress in a new course of evolution is the history [368] of the Christian Churches, orthodox and heterodox. The steps in this evolution are obvious. The first is the birth of a new theological scheme arising out of the union of elements derived from Greek philosophy with elements derived from Israelitic theology. In the fourth Gospel, the Logos, raised to a somewhat higher degree of personification than in the Alexandrian theosophy, is identified with Jesus of Nazareth. In the Epistles, especially the later of those attributed to Paul, the Israelitic ideas of the Messiah and of sacrificial atonement coalesce with one another and with the embodiment of the Logos in Jesus, until the apotheosis of the Son of man is almost, or quite, effected. The history of Christian dogma, from Justin to Athanasius, is a record of continual progress in the same direction, until the fair body of religion, revealed in almost naked purity by the prophets, is once more hidden under a new accumulation of dogmas and of ritual practices of which the primitive Nazarene knew nothing; and which he would

probably have regarded as blasphemous if he could have been made to understand them.

As, century after century, the ages roll on, polytheism comes back under the disguise of Mariolatry and the adoration of saints; image-worship becomes as rampant as in old Egypt; adoration of relics takes the place of the old fetish-worship; the virtues of the ephod pale before those of holy coats and handkerchiefs; shrines and calvaries [369] make up for the loss of the ark and of the high places; and even the lustral fluid of paganism is replaced by holy water at the porches of the temples. A touching ceremony–the common meal originally eaten in pious memory of a loved teacher–becomes metamorphosed into a flesh-and-blood sacrifice, supposed to possess exactly that redeeming virtue which the prophets denied to the flesh-and-blood sacrifices of their day; while the minute observance of ritual is raised to a degree of punctilious refinement which Levitical legislators might envy. And with the growth of this theology, grew its inevitable concomitant, the belief in evil spirits, in possession, in sorcery, in charms and omens, until the Christians of the twelfth century after our era were sunk in more debased and brutal superstitions than are recorded of the Israelites in the twelfth century before it.

The greatest men of the Middle Ages are unable to escape the infection. Dante's "Inferno" would be revolting if it were not so often sublime, so often exquisitely tender. The hideous pictures which cover a vast space on the south wall of the Campo Santo of Pisa convey information, as terrible as it is indisputable, of the theological conceptions of Dante's countrymen in the fourteenth century, whose eyes were addressed by the painters of those disgusting scenes, and whose approbation they knew how to win. A candid Mexican of the time of Cortez, could he have seen this [370] Christian burial-place, would have taken it for an appropriately adorned Teocalli. The professed disciple of the God of justice and of mercy might there gloat over the sufferings of his fellowmen depicted as undergoing every extremity of atrocious and sanguinary torture to all eternity, for theological errors no less than for moral delinquencies; while, in the central figure of Satan,[35] occupied in champing up souls in his capacious and well-toothed jaws, to void them again for the purpose of undergoing fresh suffering, we have the counterpart of the strange Polynesian and Egyptian dogma that there were certain gods who employed themselves in devouring the ghostly flesh of the Spirits of the dead. But in justice to the Polynesians, it must be recollected that, after three such operations, they thought the soul was purified and happy. In the view of the Christian theologian the operation was only a preparation for new tortures continued for ever and aye.

With the growth of civilisation in Europe, and with the revival of letters and of science in the [371] fourteenth and fifteenth centuries, the ethical and intellectual criticism of theology once more recommenced, and arrived at a temporary resting-place in the confessions of the various reformed Protestant sects in the sixteenth century; almost all of which, as soon as they were strong enough, began to persecute those who carried criticism beyond their own limit. But the movement was not arrested by these ecclesiastical barriers, as their constructors fondly imagined it would be; it was continued, tacitly or openly, by Galileo, by Hobbes, by Descartes, and especially by Spinoza, in the seventeenth century; by the English Freethinkers, by Rousseau, by the French Encyclopædists, and by the German Rationalists, among whom Lessing stands out a head and shoulders taller than the rest, throughout the eighteenth century; by the historians, the philologers, the Biblical critics, the geologists, and the

biologists in the nineteenth century, until it is obvious to all who can see that the moral sense and the really scientific method of seeking for truth are once more predominating over false science. Once more ethics and theology are parting company.

It is my conviction that, with the spread of true scientific culture, whatever may be the medium, historical, philological, philosophical, or physical, through which that culture is conveyed, and with its necessary concomitant, a constant elevation of the standard of veracity, the end of the evolution [372] of theology will be like its beginning–it will cease to have any relation to ethics. I suppose that, so long as the human mind exists, it will not escape its deep-seated instinct to personify its intellectual conceptions. The science of the present day is as full of this particular form of intellectual shadow-worship as is the nescience of ignorant ages. The difference is that the philosopher who is worthy of the name knows that his personified hypotheses, such as law, and force, and ether, and the like, are merely useful symbols, while the ignorant and the careless take them for adequate expressions of reality. So, it may be, that the majority of mankind may find the practice of morality made easier by the use of theological symbols. And unless these are converted from symbols into idols, I do not see that science has anything to say to the practice, except to give an occasional warning of its dangers. But, when such symbols are dealt with as real existences, I think the highest duty which is laid upon men of science is to show that these dogmatic idols have no greater value than the fabrications of men's hands, the stocks and the stones, which they have replaced.

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[1] Even the most sturdy believers in the popular theory that the proper or titular names attached to the books of the Bible are those of their authors will hardly be prepared to maintain that Jephthah, Gideon, and their colleagues wrote the book of Judges. Nor is it easily admissible that Samuel wrote the two books which pass under his name, one of which deals entirely with events which took place after his death. In fact, no one knows who wrote either Judges or Samuel, nor when, within the range of 100 years, their present form was given to these books.

[2] My citations are taken from the Revised Version, but for Lord and God I have substituted Jahveh and Elohim.

[3] I need hardly say that I depend upon authoritative Biblical critics, whenever a question of interpretation of the text arises. As Reuss appears to me to be one of the most learned, acute, and fair-minded of those whose works I have studied, I have made most use of the commentary and dissertations in his splendid French edition of the Bible. But I have also had recourse to the works of Dillman, Kalisch, Kuenen, Thenius, Tuch, and others, in cases in which another opinion seemed desirable.

[4] See "Divination," by Hazoral, *Journal of Anthropology*, Bombay, vol. i. No. 1.

[5] See, for example, the message of Jephthah to the King of the Ammonites: "So now Jahveh, the Elohim of Israel, hath dispossessed the Amorites from before his people Israel, and shouldest thou possess them? Wilt not thou possess that which Chemosh, thy Elohim, giveth thee to possess?" (Jud. xi. 23, 24). For Jephthah, Chemosh is obviously as real a personage as Jahveh.

[6] For example: "My oblation, my food for my offerings made by fire, of a sweet savour to me, shall ye observe to offer unto me in their due season" (Num. xxviii. 2).

[7] In 2 Samuel xv. 27 David says to Zadok the priest, "Art thou not a seer?" and Gad is called David's seer.

[8] This would at first appear to be inconsistent with the use of the word "prophetess" for Deborah. But it does not follow because the writer of Judges applies the name to Deborah that it was used in her day.

[9] Samuel tells the cook, "Bring the potion which I gave thee, of which I said to thee, Set it by thee." It was therefore Samuel's to give. "And the cook took up the thigh (or shoulder) and that which was upon it and set it before Saul." But, in the Levitical regulations, it is the thigh (or shoulder) which becomes the priest's own property. "And the right thigh (or shoulder) shall ye give onto the priest for an heave-offering," which is given along with the wave breast "unto Aaron the priest and unto his sons as a due for ever from the children of Israel" (Lev. vii. 31-34). Reuss writes on this passage: "La cuisse n'est point agitée, mais simplement *prélevée* sur ce que les convives mangeront."

[10] See, for example, Elkanah's sacrifice, 1 Sam. i. 3-9.

[11] The ghost was not supposed to be capable of devouring the gross material substance of the offering; but his vaporous body appropriated the smoke of the burnt sacrifice, the visible and odorous exhalations of other offerings. The blood of the victim was particularly useful because it was thought to be the special seat of its soul or life. A West African negro replied to an European sceptic: "Of course, the spirit cannot eat corporeal food, but he extracts its spiritual part, and, as we see, leaves the material part behind" (Lippert, *Seelencult,* p. 16),

[12] It is further well worth consideration whether indications of former ancestor-worship are not to be found in the singular weight attached to the veneration of parents in the fourth commandment. It is the only positive commandment, in addition to those respecting the Deity and that concerning the Sabbath, and the penalties for infringing it were of the same character. In China, a corresponding reverence for parents is part and parcel of ancestor-worship; so in ancient Rome and in Greece (where parents were even called [secondary and earthly]). The fifth commandment, as it stands, would be an excellent compromise between ancestor-worship and monotheism. The larger hereditary share allotted by Israelitic law to the eldest son reminds one of the privileges attached to primogeniture in ancient Rome, which were closely connected with ancestor-worship. There is a good deal to be said in favour of the speculation that the ark of the covenant may have been a relic of ancestor-worship; but that topic is too large to be dealt with incidentally in this place

[13] "The Scientific Aspects of Positivism," *Fortnightly Review,* 1869, republished in *Lay Sermons.*

[14] Œuvres de Bossuet, ed. 1808, t. xxxv. p. 282.

[15] I should like further to add the expression of my indebtedness to two works by Herr Julius Lippert, *Der Seelencult in seinen Beziehungen zur alt-hebraischen Religion* and *Die Religionen der europäischen Culturvölker,* both pubished in 1881. I have found them full of valuable suggestions.

[16] See among others the remarkable work of Fustel de Coulanges, *La Cité antique,* in which the social

importance of the old Roman ancestor-worship is brought out with great clearness.

17 Supposed to be "the finer or more aeriform part of the body," standing in "the same relation to the body as the perfume and the more essential qualities of a flower do to the more solid substances" (Mariner, vol. ii. p. 127).

18 A kind of "clients" in the Roman sense.

19 It is worthy of remark that daiuwv among the Greeks, and *Deus* among the Romans, had the same wide signification. The *dii manes* were ghosts of ancestors=Atuas of the family.

20 *Voyages aux îles du Grand Ocean,* t. i. p. 482.

21 *Te Ika a Maui: New Zealand and its Inhabitants,* p. 72.

22 Compare: "And Samuel said unto Saul, Why hast thou disquieted me?" (I Sam. xxviii. l5)

23 Turner, *Nineteen Years in Polynesia,* p. 238.

24 See Lippert's excellent remarks on this subject, *Der Seelencult,* p. 89.

25 *Sciography* has the authority of Cudworth, *Intellectual System,* vol. ii. p. 836. Sciomancy [...], which, in the sense of divination by ghosts, may be found in Bailey's *Dictionary* (1751) also furnishes a precedent for my coinage.

26 "Kami" is used in the sense of Elohim; and is also, like our word "Lord," employed as a title of respect among men, as indeed Elohim was.

27 [The Assyrians thus raised Assur to a position of pre-eminence.]

28 I refer those who wish to know the reasons which lead me to take up this position to the works of Reuss and Wellhausen, [and especially to Stade's *Geschichte des Volkes Israel.*]

29 Bunsen. *Egypt's Place,* vol. v. p.129, note.

30 See Birch, in *Egypt's Place,* vol. v; and Brugsch, *History of Egypt.*

31 Even by Graetz, who, though a fair enough historian, cannot be accused of any desire to over-estimate the importance of Egyptian influence upon his people.

32 Graetz, *Geschichte der Juden,* Bd. i. p. 370.

[33] See the careful analsyis of the work of the Alexandrian philosopher and theologian (who, it should be remembered, was a most devout Jew, held in the highest esteem by his country men) in Siegfried's *Philo von Alexandrien,* 1875. [Also Dr. J. Drummond's *Philo Judæus,* 1888.]

[34] I am not unaware of the existence of many and widely divergent sects and schools among the Jews at all periods of their history, since the dispersion. But I imagine that orthodox Judaism is now pretty much what it was in Philo's time; while Peter and Paul, if they could return to life, would certainly have to learn the catechism of either the Roman, Greek, or Anglican Churches, if they desired to be considered orthodox Christians.

[35] Dante's description of Lucifer engaged in the eternal mastication of Brutus, Cassius, and Judas Iscariot–

> "Da ogni bocca dirompea co' denti
> Un peccatore, a guisa di maciulla,
> Si che tre ne facea così dolenti.
> A quel dinanzi il mordere era nulla,
> Verso 'l graffiar, chè tal volta la schiena
> Rimanea della pelle tutta brulla"–

is quite in harmony with the Pisan picture and perfectly Polynesian in conception.

THE HUXLEY FILE

Preface and Table of Contents to Volume IV, *Science and Hebrew Tradition,* of Huxley's *Collected Essays.*

Previous article: Hasisadra's Adventure [1881], pages 239-286.

Preface and Table of Contents to the next volume, Volume V of Huxley's *Collected Essays.*

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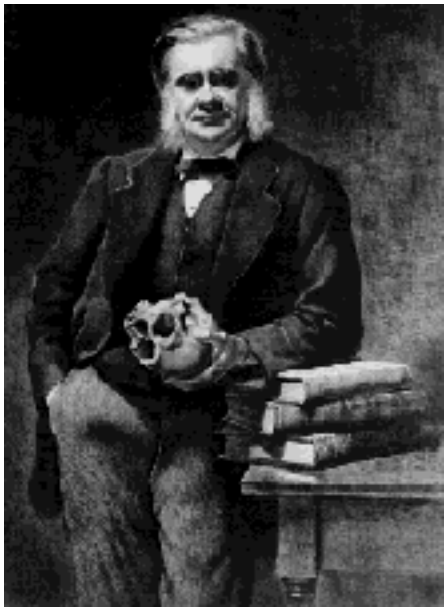

Prologue to Controverted Questions

Essays upon Some Controverted Questions (1892)

Collected Essays V

[1] Le plus grand service qn'on puisse rendre à la science est d'y faire place nette avant d'y rien construire.–Cuvier

Most of the Essays comprised in the present volume have been written during the last six or seven years, without premeditated purpose or intentional connection, in reply to attacks upon doctrines which I hold to be well founded; or in refutation of allegations respecting matters lying within the province of natural knowledge, which I believe to be erroneous; and they bear the mark of their origin in the controversial tone which pervades them.

Of polemical writing, as of other kinds of warfare, I think it may be said, that it is often useful, sometimes necessary, and always more or less of an evil. It is useful, when it attracts attention to topics which might otherwise be neglected; and when, as does sometimes happen, those who come to see a contest remain to think. It is necessary, [2] when the interests of truth and of justice are at stake. It is an evil, in so far as controversy always tends to degenerate into quarrelling, to swerve from the great issue of what is right and what is wrong to the very small question of who is right and who is wrong. I venture to hope that the useful and the necessary were more conspicuous than the evil attributes of literary militancy, when these papers were first published; but I have had some hesitation about reprinting them. If I may judge by my own taste, few literary dishes are less appetising than cold controversy; moreover, there is an air of unfairness about the presentation of only one side of a discussion, and a flavour of unkindness in the reproduction of "winged words," which, however appropriate at the time of their utterance, would find a still more appropriate place in oblivion. Yet, since I could hardly ask those who have honoured me by their polemical attentions to confer lustre on this collection, by permitting me to present their lucubrations along with my own; and since it would be a manifest wrong to them to deprive their, by no means rare, vivacities of language of such justification as they may derive from similar freedoms on my part; I came to the conclusion that my best course was to leave the essays just as they were written;[1] assuring my [3] honourable adversaries than any heat of which signs may remain was generated, in accordance with the law of the conservation of energy, by the force of their own blows, and has long since been dissipated into space.

But, however the polemical concomitants of these discussions may be regarded–or better, disregarded–there is no doubt either about the importance of the topics of which they treat, or as to the public interest in the "Controverted Questions" with which they deal. Or rather, the Controverted Question; for disconnected as these pieces may, perhaps, appear to be, they are, in fact, concerned only with different aspects of a single problem, with which thinking men have been occupied, ever since they began seriously to consider the wonderful frame of things in which their lives are set, and to seek for trustworthy guidance among its intricacies.

Experience speedily taught them that the shifting scenes of the world's stage have a permanent background; that there is order amidst the seeming confusion, and that many events take place according to unchanging rules. To this region of familiar steadiness and customary regularity they gave the name of Nature. But at the same time, their infantile and untutored reason, little more, as yet, than the playfellow of the imagination, led them to believe that this tangible, commonplace, orderly world of Nature was sur[4]rounded and interpenetrated by another intangible and mysterious world, no more bound by fixed rules than, as they fancied, were the thoughts and passions which coursed through their minds and seemed to exercise an intermittent and capricious rule over their bodies. They attributed to the entities, with which they peopled this dim and dreadful region, an unlimited amount of that power of modifying the course of events of which they themselves possessed a small share, and thus came to regard them as not merely beyond, but above, Nature.

Hence arose the conception of a "Supernature" antithetic to "Nature"–the primitive dualism of a natural world "fixed in fate" and a supernatural, left to the free play of volition–which has pervaded all later speculation and, for thousands of years, has exercised a profound influence on practice. For it is obvious that, on this theory of the Universe, the successful conduct of life must demand careful attention to both worlds; and, if either is to be neglected, it may be safer that it should be Nature. In any given contingency, it must doubtless be desirable to know what may be expected to happen in the ordinary course of things; but it must be quite as necessary to have some inkling of the line likely to be taken by supernatural agencies able, and possibly willing, to suspend or reverse that course. Indeed, logically developed, the dualistic theory [5] must needs end in almost exclusive attention to Supernature, and in trust that its over-ruling strength will be exerted in favour of those who stand well with its denizens. On the other hand, the lessons of the great schoolmaster, experience, have hardly seemed to accord with this conclusion. They have taught, with considerable emphasis, that it does not answer to neglect Nature; and that, on the whole, the more attention paid to her dictates the better men fare.

Thus the theoretical antithesis brought about a practical antagonism. From the earliest times of which we have any knowledge, Naturalism and Supernaturalism have consciously, or unconsciously, competed and struggled with one another; and the varying fortunes of the contest are written in the records of the course of civilisation, from those of Egypt and Babylonia, six thousand years ago, down to those of our own time and people.

These records inform us that, so far as men have paid attention to Nature, they have been rewarded for their pains. They have developed the Arts which have furnished the conditions of civilised existence; and the Sciences, which have been a progressive revelation of reality and have afforded the best discipline of the mind in the methods of discovering truth. They have accumulated a vast body of universally accepted knowledge; and the conceptions of man and of society, [6] of morals and of law, based upon that knowledge, are every day more and more, either openly or tacitly, acknowledged to be the foundations of right action.

History also tells us that the field of the supernatural has rewarded its cultivators with a harvest, perhaps not less luxuriant, but of a different character. It has produced an almost infinite diversity of Religions.

These, if we set aside the ethical concomitants upon which natural knowledge also has a claim, are composed of information about Supernature; they tell us of the attributes of supernatural beings, of their relations with Nature, and of the operations by which their interference with the ordinary course of events can be secured or averted. It does not appear, however, that supernaturalists have attained to any agreement about these matters, or that history indicates a widening of the influence of supernaturalism on practice, with the onward flow of time. On the contrary, the various religions are, to a great extent, mutually exclusive; and their adherents delight in charging each other, not merely with error, but with criminality, deserving and ensuing punishment of infinite severity. In singular contrast with natural knowledge, again, the acquaintance of mankind with the supernatural appears the more extensive and the more exact, and the influence of supernatural doctrines upon conduct the greater, [7] the further back we go in time and the lower the stage of civilisation submitted to investigation. Historically, indeed, there would seem to be an inverse relation between supernatural and natural knowledge. As the latter has widened, gained in precision and in trustworthiness, so has the former shrunk, grown vague and questionable; as the one has more and more filled the sphere of action, so has the other retreated into the region of meditation, or vanished behind the screen of mere verbal recognition.

Whether this difference of the fortunes of Naturalism and of Supernaturalism is an indication of the progress, or of the regress, of humanity; of a fall from, or an advance towards, the higher life; is a matter of opinion. The point to which I wish to direct attention is that the difference exists and is making itself felt. Men are growing to be seriously alive to the fact that the historical evolution of humanity, which is generally, and I venture to think not unreasonably, regarded as progress, has been, and is being, accompanied by a co-ordinate elimination of the supernatural from its originally large occupation of men's thoughts. The question–How far is this process to go?–is, in my apprehension, the Controverted Question of our time.

Controversy on this matter–prolonged, bitter, and fought out with the weapons of the flesh, as [8] well as with those of the spirit–is no new thing to Englishmen. We have been more or less occupied with it these five hundred years. And, during that time, we have made attempts to establish a *modus vivendi* between the antagonists, some of which have had a world-wide influence; though, unfortunately, none have proved universally and permanently satisfactory.

In the fourteenth century, the controverted question among us was, whether certain portions of the Supernaturalism of mediæval Christianity were well-founded. John Wicliff proposed a solution of the problem which, in the course of the following two hundred years, acquired wide popularity and vast historical importance: Lollards, Hussites, Lutherans, Calvinists, Zwinglians, Socinians, and Anabaptists, whatever their disagreements, concurred in the proposal to reduce the Supernaturalism of Christianity within the limits sanctioned by the Scriptures. None of the chiefs of Protestantism called in question either the supernatural origin and infallible authority of the Bible, or the exactitude of the account of the supernatural world given in its pages. In fact, they could not afford to entertain any doubt about these points, since the infallible Bible was the fulcrum of the lever with which they were endeavouring to upset the Chair of St. Peter. The "freedom of private judgment" which they proclaimed, meant no more, in practice, than [9] permission to themselves to make free with the public judgment of the Roman Church, in respect of the canon and of the meaning to be attached to the words of the canonical books.

Private judgment–that is to say, reason–was (theoretically, at any rate) at liberty to decide what books were and what were not to take the rank of "Scripture"; and to determine the sense of any passage in such books. But this sense, once ascertained to the mind of the sectary, was to be taken for pure truth–for the very word of God. The controversial efficiency of the principle of biblical infallibility lay in the fact that the conservative adversaries of the Reformers were not in a position to contravene it without entangling themselves in serious difficulties; while, since both Papists and Protestants agreed in taking efficient measures to stop the mouths of any more radical critics, these did not count.

The impotence of their adversaries, however, did not remove the inherent weakness of the position of the Protestants. The dogma of the infallibility of the Bible is no more self-evident than is that of the infallibility of the Pope. If the former is held by "faith," then the latter may be. If the latter is to be accepted, or rejected, by private judgment, why not the former? Even if the Bible could be proved anywhere to assert its own infallibility, the value of that self-assertion to those who dispute the point is not obvious. On [10] the other hand, if the infallibility of the Bible was rested on that of a "primitive Church," the admission that the "Church" was formerly infallible was awkward in the extreme for those who denied its present infallibility. Moreover, no sooner was the Protestant principle applied to practice, than it became evident that even an infallible text, when manipulated by private judgment, will impartially countenance contradictory deductions; and furnish forth creeds and confessions as diverse as the quality and the information of the intellects which exercise, and the prejudices and passions which sway, such judgments. Every sect, confident in the derivative infallibility of its wire-drawing of infallible materials, was ready to supply its contingent of martyrs; and to enable history, once more, to illustrate the truth, that steadfastness under persecution says much for the sincerity and still more for the tenacity, of the believer, but very little for the objective truth of that which he believes. No martyrs have sealed their faith with their blood more steadfastly than the Anabaptists.

Last, but not least, the Protestant principle contained within itself the germs of the destruction of the finality, which the Lutheran, Calvinistic, and other Protestant Churches fondly imagined they had reached. Since their creeds were professedly based on the canonical Scriptures, [11] it followed that, in the long run, whoso settled the canon defined the creed. If the private judgment of Luther might legitimately conclude that the epistle of James was contemptible, while the epistles of Paul contained the very essence of Christianity, it must be permissible for some other private judgment, on as good or as bad grounds, to reverse these conclusions; the critical process which excluded the Apocrypha could not be barred, at any rate by people who rejected the authority of the Church, from extending its operations to Daniel, the Canticles, and Ecclesiastes; nor, having got so far, was it easy to allege any good ground for staying the further progress of criticism. In fact, the logical development of Protestantism could not fail to lay the authority of the Scriptures at the feet of Reason; and, in the hands of latitudinarian and rationalistic theologians, the despotism of the Bible was rapidly converted into an extremely limited monarchy. Treated with as much respect as ever, the sphere of its practical authority was minimised; and its decrees were valid only so far as they were countersigned by common sense, the responsible minister.

The champions of Protestantism are much given to glorify the Reformation of the sixteenth century as the emancipation of Reason; but it may be doubted if their contention has any solid ground; while there is a good deal of evidence to [12] show, that aspirations after intellectual freedom had nothing whatever

to do with the movement. Dante, who struck the Papacy as hard blows as Wicliff; Wicliff himself and Luther himself, when they began their work; were far enough from any intention of meddling with even the most irrational of the dogmas of mediæval Supernaturalism. From Wicliff to Socinus, or even to Münzer, Rothmann, and John of Leyden, I fail to find a trace of any desire to set reason free. The most that can be discovered is a proposal to change masters. From being the slave of the Papacy the intellect was to become the serf of the Bible; or, to speak more accurately, of somebody's interpretation of the Bible, which, rapidly shifting its attitude from the humility of a private judgment to the arrogant Cæsaro-papistry of a state-enforced creed, had no more hesitation about forcibly extinguishing opponent private judgments and judges, than had the old-fashioned Pontiff papistry.

It was the iniquities, and not the irrationalities, of the Papal system that lay at the bottom of the revolt of the laity; which was, essentially, an attempt to shake off the intolerable burden of certain practical deductions from a Supernaturalism in which everybody, in principle, acquiesced. What was the gain to intellectual freedom of abolishing transubstantiation, image worship, indulgences, ecclesiastical infallibility; if consub[13]stantiation, real-unreal presence mystifications, the bibliolatry, the "inner-light" pretensions, and the demonology, which are fruits of the same supernaturalistic tree, remained in enjoyment of the spiritual and temporal support of a new infallibility? One does not free a prisoner by merely scraping away the rust from his shackles.

It will be asked, perhaps, was not the Reformation one of the products of that great outbreak of many-sided free mental activity included under the general head of the Renascence? Melanchthon, Ulrich von Hutten, Beza, were they not all humanists? Was not the arch-humanist, Erasmus, fautor-in-chief of the Reformation, until he got frightened and basely deserted it?

From the language of Protestant historians, it would seem that they often forget that Reformation and Protestantism are by no means convertible terms. There were plenty of sincere and indeed zealous reformers, before, during, and after the birth and growth of Protestantism, who would have nothing to do with it. Assuredly, the rejuvenescence of science and of art; the widening of the field of Nature by geographical and astronomical discovery; the revelation of the noble ideals of antique literature by the revival of classical learning; the stir of thought, throughout all classes of society, by the printers' work, loosened traditional bonds and weakened the hold of mediæval Supernaturalism. In the interests [14] of liberal culture, and of national welfare, the humanists were eager to lend a hand to anything which tended to the discomfiture of their sworn enemies, the monks, and they willingly supported every movement in the direction of weakening ecclesiastical interference with civil life. But the bond of a common enemy was the only real tie between the humanist and the protestant; their alliance was bound to be of short duration, and, sooner or later, to be replaced by internecine warfare. The goal of the humanists, whether they were aware of it or not, was the attainment of the complete intellectual freedom of the antique philosopher, than which nothing could be more abhorrent to a Luther, a Calvin, a Beza, or a Zwingli.

The key to the comprehension of the conduct of Erasmus, seems to me to lie in the clear apprehension of this fact. That he was a man of many weaknesses may be true; in fact, he was quite aware of them and professed himself no hero. But he never deserted that reformatory movement which he originally

contemplated; and it was impossible he should have deserted the specifically Protestant reformation in which he never took part. He was essentially a theological whig, to whom radicalism was as hateful as it is to all whigs; or, to borrow a still more appropriate comparison from modern times, a broad churchman who refused to enlist with either the High [15] Church or the Low Church zealots, and paid the penalty of being called coward, time-server and traitor, by both. Yet really there is a good deal in his pathetic remonstrance that he does not see why he is bound to become a martyr for that in which he does not believe; and a fair consideration of the circumstances and the consequences of the Protestant reformation seems to me to go a long way towards justifying the course he adopted.

Few men had better means of being acquainted with the condition of Europe; none could be more competent to gauge the intellectual shallowness and self-contradiction of the Protestant criticism of Catholic doctrine; and to estimate, at its proper value, the fond imagination that the waters let out by the Renascence would come to rest amidst the blind alleys of the new ecclesiasticism. The bastard, whilom poor student and monk, become the familiar of bishops and princes, at home in all grades of society, could not fail to be aware of the gravity of the social position, of the dangers imminent from the profligacy and indifference of the ruling classes, no less than from the anarchical tendencies of the people who groaned under their oppression. The wanderer who had lived in Germany, in France, in England, in Italy, and who counted many of the best and most influential men in each country among his friends, was not likely to estimate wrongly the enormous forces which were still at the command of the [16] Papacy. Bad as the churchmen might be, the statesmen were worse; and a person of far more sanguine temperament than Erasmus might have seen no hope for the future, except in gradually freeing the ubiquitous organisation of the Church from the corruptions which alone, as he imagined, prevented it from being as beneficent as it was powerful. The broad tolerance of the scholar and man of the world might well be revolted by the ruffianism, however genial, of one great light of Protestantism, and the narrow fanaticism, however learned and logical, of others; and to a cautious thinker, by whom, whatever his shortcomings, the ethical ideal of the Christian evangel was sincerely prized, it really was a fair question, whether it was worth while to bring about a political and social deluge, the end of which no mortal could foresee, for the purpose of setting up Lutheran, Zwinglian, and other Peterkins, in the place of the actual claimant to the reversion of the spiritual wealth of the Galilean fisherman.

Let us suppose that, at the beginning of the Lutheran and Zwinglian movement, a vision of its immediate consequences had been granted to Erasmus; imagine that to the spectre of the fierce outbreak of Anabaptist communism, which opened the apocalypse, had succeeded, in shadowy procession, the reign of terror and of spoliation in England, with the judicial murders of his friends, More and Fisher; the bitter tyranny of evangel[17]istic clericalism in Geneva and in Scotland; the long agony of religious wars, persecutions, and massacres, which devastated France and reduced Germany almost to savagery; finishing with the spectacle of Lutheranism in its native country sunk into mere dead Erastian formalism, before it was a century old; while Jesuitry triumphed over Protestantism in three-fourths of Europe, bringing in its train a recrudescence of all the corruptions Erasmus and his friends sought to abolish; might not he have quite honestly thought this a somewhat too heavy price to pay for Protestantism; more especially, since no one was in a better position than himself to know how little the dogmatic foundation of the new confessions was able to bear the light which the inevitable progress of humanistic criticism would throw upon them? As the wiser of his contemporaries saw, Erasmus was, at

heart, neither Protestant nor Papist, but an "Independent Christian"; and, as the wiser of his modern biographers have discerned, he was the precursor, not of sixteenth century reform, but of eighteenth century "enlightenment"; a sort of broad-church Voltaire, who held by his "Independent Christianity" as stoutly as Voltaire by his Deism.

In fact, the stream of the Renascence, which bore Erasmus along, left Protestantism stranded amidst the mudbanks of its articles and creeds: while its true course became visible to all men, [18] two centuries later. By this time, those in whom the movement of the Renascence was incarnate became aware what spirit they were of; and they attacked Supernaturalism in its Biblical stronghold, defended by Protestants and Romanists with equal zeal. In the eyes of the "Patriarch," Ultramontanism, Jansenism, and Calvinism were merely three persons of the one "Infâme" which it was the object of his life to crush. If he hated one more than another, it was probably the last; while D'Holbach, and the extreme left of the free-thinking host, were disposed to show no more mercy to Deism and Pantheism.

The sceptical insurrection of the eighteenth century made a terrific noise and frightened not a few worthy people out of their wits; but cool judges might have foreseen, at the outset, that the efforts of the later rebels were no more likely than those of the earlier, to furnish permanent resting-places for the spirit of scientific inquiry. However worthy of admiration may be the acuteness, the common sense, the wit, the broad humanity, which abound in the writings of the best of the free-thinkers; there is rarely much to be said for their work as an example of the adequate treatment of a grave and difficult investigation. I do not think any impartial judge will assert that, from this point of view, they are much better than their adversaries. It must be admitted that they share to the full the fatal [19] weakness of *a priori* philosophising, no less than the moral frivolity common to their age; while a singular want of appreciation of history, as the record of the moral and social evolution of the human race, permitted them to resort to preposterous theories of imposture, in order to account for the religious phenomena which are natural products of that evolution.

For the most part, the Romanist and Protestant adversaries of the free-thinkers met them with arguments no better than their own; and with vituperation, so far inferior that it lacked the wit. But one great Christian Apologist fairly captured the guns of the free-thinking array, and turned their batteries upon themselves. Speculative "infidelity" of the eighteenth century type was mortally wounded by the *Analogy;* while the progress of the historical and psychological sciences brought to light the important part played by the mythopoeic faculty; and, by demonstrating the extreme readiness of men to impose upon themselves, rendered the calling in of sacerdotal cooperation, in most cases, a superfluity.

Again, as in the fourteenth and the sixteenth centuries, social and political influences came into play. The free-thinking *philosophes,* who objected to Rousseau's sentimental religiosity almost a much as they did to *L'Infâme,* were credited with the responsibility for all the evil deeds of Rousseau's Jacobin disciples, with about as much [20] justification as Wicliff was held responsible for the Peasants' revolt, or Luther for the *Bauern-krieg.* In England, though our *ancien régime* was not altogether lovely, the social edifice was never in such a bad way as in France; it was still capable of being repaired; and our forefathers, very wisely, preferred to wait until that operation could be safely performed, rather than pull it all down about their ears, in order to build a philosophically planned house on brand-new speculative

foundations. Under these circumstances, it is not wonderful that, in this country, practical men preferred the gospel of Wesley and Whitfield to that of Jean Jacques; while enough of the old leaven of Puritanism remained to ensure the favour and support of a large number of religious men to a revival of evangelical supernaturalism. Thus, by degrees, the free-thinking, or the indifference, prevalent among us in the first half of the eighteenth century, was replaced by a strong supernaturalistic reaction, which submerged the work of the free-thinkers; and even seemed, for a time, to have arrested the naturalistic movement of which that work was an imperfect indication. Yet, like Lollardry, four centuries earlier, freethought merely took to running underground, safe, sooner or later, to return to the surface.

My memory, unfortunately, carries me back to the fourth decade of the nineteenth century, when the [21] evangelical flood had a little abated and the tops of certain mountains were soon to appear, chiefly in the neighbourhood of Oxford; but when nevertheless, bibliolatry was rampant; when church and chapel alike proclaimed, as the oracles of God, the crude assumptions of the worst informed and, in natural sequence, the most presumptuously bigoted, of all theological schools.

In accordance with promises made on my behalf, but certainly without my authorisation, I was very early taken to hear "sermons in the vulgar tongue." And vulgar enough often was the tongue in which some preacher, ignorant alike of literature, of history, of science, and even of theology, outside that patronised by his own narrow school, poured forth, from the safe entrenchment of the pulpit, invectives against those who deviated from his notion of orthodoxy. From dark allusions to "sceptics" and "infidels," I became aware of the existence of people who trusted in carnal reason; who audaciously doubted that the world was made in six natural days, or that the deluge was universal; perhaps even went so far as to question the literal accuracy of the story of Eve's temptation, or of Balaam's ass; and, from the horror of the tones in which they were mentioned, I should have been justified in drawing the conclusion that these rash men belonged to the criminal classes. At the same time, those who were more directly responsible for providing me [22] with the knowledge essential to the right guidance of life (and who sincerely desired to do so), imagined they were discharging that most sacred duty by impressing upon my childish mind the necessity, on pain of reprobation in this world and damnation in the next, of accepting, in the strict and literal sense, every statement contained in the Protestant Bible. I was told to believe, and I did believe, that doubt about any of them was a sin, not less reprehensible than a moral delict. I suppose that, out of a thousand of my contemporaries, nine hundred, at least, had their minds systematically warped and poisoned, in the name of the God of truth, by like discipline. I am sure that, even a score of years later, those who ventured to question the exact historical accuracy of any part of the Old Testament and *a fortiori* of the Gospels, had to expect a pitiless shower of verbal missiles, to say nothing of the other disagreeable consequences which visit those who, in any way, run counter to that chaos of prejudices called public opinion.

My recollections of this time have recently been revived by the perusal of a remarkable document,[2] signed by as many as thirty-eight out of the twenty odd thousand clergymen of the Established Church. It does not appear that the signataries are officially accredited spokesmen of the ecclesias[23]tical corporation to which they belong; but I feel bound to take their word for it, that they are "stewards of the Lord, who have received the Holy Ghost," and, therefore, to accept this memorial as evidence that,

though the Evangelicism of my early days may be deposed from its place of power, though so many of the colleagues of the thirty-eight even repudiate the title of Protestants, yet the green bay tree of bibliolatry flourishes as it did sixty years ago. And, as in those good old times, whoso refuses to offer incense to the idol is held to be guilty of "a dishonour to God," imperilling his salvation.

It is to the credit of the perspicacity of the memorialists that they discern the real nature of the Controverted Question of the age. They are awake to the unquestionable fact that, if Scripture has been discovered "not to be worthy of unquestioning belief," faith "in the supernatural itself" is, so far, undermined. And I may congratulate myself upon such weighty confirmation of an opinion in which I have had the fortune to anticipate them. But whether it is more to the credit of the courage, than to the intelligence, of the thirty-eight that they should go on to proclaim that the canonical scriptures of the Old and New Testaments "declare incontrovertibly the actual historical truth in all records, both of past events and of the delivery of predictions to be thereafter fulfilled," must be left to the coming generation to decide.

[24] The interest which attaches to this singular document will, I think, be based by most thinking men, not upon what it is, but upon that of which it is a sign. It is an open secret, that the memorial is put forth as a counterblast to a manifestation of opinion of a contrary character, on the part of certain members of the same ecclesiastical body, who therefore have, as I suppose, an equal right to declare themselves "stewards of the Lord and recipients of the Holy Ghost." In fact, the stream of tendency towards Naturalism, the course of which I have briefly traced, has, of late years, flowed so strongly, that even the Churches have begun, I dare not say to drift, but, at any rate, to swing at their moorings. Within the pale of the Anglican establishment, I venture to doubt, whether, at this moment, there are as many thorough-going defenders of "plenary inspiration" as there were timid questioners of that doctrine, half a century ago. Commentaries, sanctioned by the highest authority, give up the "actual historical truth" of the cosmogonical and diluvial narratives. University professors of deservedly high repute accept the critical decision that the Hexateuch is a compilation, in which the share of Moses, either as author or as editor, is not quite so clearly demonstrable as it might be; highly placed Divines tell us that the pre-Abrahamic Scripture narratives may be ignored; that the book of Daniel may be regarded as a [25] patriotic romance of the second century B.C.; that the words of the writer of the fourth Gospel are not always to be distinguished from those which he puts into the mouth of Jesus. Conservative, but conscientious, revisers decide that whole passages, some of dogmatic and some of ethical importance, are interpolations. An uneasy sense of the weakness of the dogma of Biblical infallibility seems to be at the bottom of a prevailing tendency once more to substitute the authority of the "Church" for that of the Bible. In my old age, it has happened to me to be taken to task for regarding Christianity as a "religion of a book" as gravely as, in my youth, I should have been reprehended for doubting that proposition. It is a no less interesting symptom that the State Church seems more and more anxious to repudiate all complicity with the principles of the Protestant Reformation and to call itself "Anglo-Catholic." Inspiration, deprived of its old intelligible sense, is watered down into a mystification. The Scriptures are, indeed, inspired; but they contain a wholly undefined and indefinable "human element"; and this unfortunate intruder is converted into a sort of biblical whipping boy. Whatsoever scientific investigation, historical or physical, proves to be erroneous, the "human element" bears the blame; while the divine inspiration of such statements, as by their nature are out of reach of proof or disproof, is [26]

still asserted with all the vigour inspired by conscious safety from attack. Though the proposal to treat the Bible "like any other book" which caused so much scandal, forty years ago, may not yet be generally accepted, and though Bishop Colenso's criticisms may still lie, formally, under ecclesiastical ban, yet the Church has not wholly turned a deaf ear to the voice of the scientific tempter; and many a coy divine, while "crying I will ne'er consent," has consented to the proposals of that scientific criticism which the memorialists renounce and denounce.

A humble layman, to whom it would seem the height of presumption to assume even the unconsidered dignity of a "steward of science," may well find this conflict of apparently equal ecclesiastical authorities perplexing–suggestive, indeed, of the wisdom of postponing attention to either, until the question of precedence between them is settled. And this course will probably appear the more advisable, the more closely the fundamental position of the memorialists is examined.

"No opinion of the fact or form of Divine Revelation, founded on literary criticism [and I suppose I may add historical, or physical, criticism] of the Scriptures themselves, can be admitted to interfere with the traditionary testimony of the Church, when that has been once ascertained and verified by appeal to antiquity."[3]

[27] Grant that it is "the traditionary testimony of the Church" which guarantees the canonicity of each and all of the books of the Old and New Testaments. Grant also that canonicity means infallibility; yet, according to the thirty-eight, this "traditionary testimony" has to be "ascertained and verified by appeal to antiquity." But "ascertainment and verification" are purely intellectual processes, which must be conducted according to the strict rules of scientific investigation, or be self-convicted of worthlessness. Moreover, before we can set about the appeal to "antiquity," the exact sense of that usefully vague term must be defined by similar means "Antiquity" may include any number of centuries, great or small; and whether "antiquity" is to comprise the Council of Trent, or to stop a little beyond that of Nicæa, or to come to an end in the time of Irenæus, or in that of Justin Martyr, are knotty questions which can be decided, if at all, only by those critical methods which the signataries treat so cavalierly. And yet the decision of these questions is fundamental, for as the limits of the canonical scriptures vary, so may the dogmas deduced from them require modification. Christianity is one thing, if the fourth Gospel, the Epistle to the Hebrews, the pastoral Epistles, and the Apocalypse are canonical and (by the hypothesis) infallibly true; and another thing, if they are not. [28] As I have already said, whoso defines the canon defines the creed.

Now it is quite certain with respect to some of these books, such as the Apocalypse and the Epistle to the Hebrews, that the Eastern and the Western Church differed in opinion for centuries; and yet neither the one branch nor the other can have considered its judgment infallible, since they eventually agreed to a transaction by which each gave up its objection to the book patronised by the other. Moreover, the "fathers" argue (in a more or less rational manner) about the canonicity of this or that book, and are by no means above producing evidence, internal and external, in favour of the opinions they advocate. In fact, imperfect as their conceptions of scientific method may be, they not unfrequently used it to the best of their ability. Thus it would appear that though science, like Nature, may be driven out with a fork,

ecclesiastical or other, yet she surely comes back again. The appeal to "antiquity" is, in fact, an appeal to science, first to define what antiquity is; secondly, to determine what "antiquity," so defined, says about canonicity; thirdly, to prove that canonicity means infallibility. And when science, largely in the shape of the abhorred "criticism," has answered this appeal, and has shown that "antiquity" used her own methods, however clumsily and imperfectly, she naturally turns round upon the appellants, and demands [29] that they should show cause why, in these days, science should not resume the work the ancients did so imperfectly, and carry it out efficiently.

But no such cause can be shown. If "antiquity" permitted Eusebius, Origen, Tertullian, Irenæus, to argue for the reception of this book into the canon and the rejection of that, upon rational grounds, "antiquity" admitted the whole principle of modern criticism. If Irenæus produces ridiculous reasons for limiting the Gospels to four, it was open to any one else to produce good reasons (if he had them) for cutting them down to three, or increasing them to five. If the Eastern branch of the Church had a right to reject the Apocalypse and accept the Epistle to the Hebrews, and the Western an equal right to accept the Apocalypse and reject the Epistle, down to the fourth century, any other branch would have an equal right, on cause shown, to reject both, or, as the Catholic Church afterwards actually did, to accept both.

Thus I cannot but think that the thirty-eight are hoist with their own petard. Their "appeal to antiquity" turns out to be nothing but a roundabout way of appealing to the tribunal, the jurisdiction of which they affect to deny. Having rested the world of Christian supernaturalism on the elephant of biblical infallibility, and furnished the elephant with standing ground on the tortoise of "antiquity," they, like their famous Hindoo analogue, have been content to look no further; and have thereby been spared the horror of discovering that the tortoise [30] rests on a grievously fragile construction, to a great extent the work of that very intellectual operation which they anathematise and repudiate.

Moreover, there is another point to be considered. It is of course true that a Christian Church (whether the Christian Church, or not, depends on the connotation of the definite article) existed before the Christian scriptures; and that the infallibility of these depends upon the infallibility of the judgment of the persons who selected the books of which they are composed, out of the mass of literature current among the early Christians. The logical acumen of Augustine showed him that the authority of the Gospel he preached must rest on that of the Church to which he belonged.[4] But it is no less true that the Hebrew and the Septuagint versions of most, if not all, of the Old Testament books existed before the birth of Jesus of Nazareth; and that their divine authority is presupposed by, and therefore can hardly depend upon, the religious body constituted by his disciples. As everybody knows, the very conception of a "Christ" is purely [31] Jewish. The validity of the argument from the Messianic prophecies vanishes unless their infallible authority is granted; and, as a matter of fact, whether we turn to the Gospels, the Epistles, or the writings of the early Apologists, the Jewish scriptures are recognised as the highest court of appeal of the Christian.

The proposal to cite Christian "antiquity" as a witness to the infallibility of the Old Testament, when its own claims to authority vanish, if certain propositions contained in the Old Testament are erroneous, hardly satisfies the requirements of lay logic. It is as if a claimant to be sole legatee, under another kind

of testament, should offer his assertion as sufficient evidence of the validity of the will. And, even were not such a circular, or rather rotatory, argument, that the infallibility of the Bible is testified by the infallible Church, whose infallibility is testified by the infallible Bible, too absurd for serious consideration, it remains permissible to ask, Where and when the Church, during the period of its infallibility, as limited by Anglican dogmatic necessities, has officially decreed the "actual historical truth of all records" in the Old Testament? Was Augustine heretical when he denied the actual historical truth of the record of the Creation? Father Suarez, standing on later Roman tradition, may have a right to declare that he was; but it does not lie in the mouth of those who limit their [32] appeal to that early "antiquity," in which Augustine played so great a part, to say so.

Among the watchers of the course of the world of thought, some view with delight and some with horror, the recrudescence of Supernaturalism which manifests itself among us, in shapes ranged along the whole flight of steps, which, in this case, separates the sublime from the ridiculous–from Neo-Catholicism and Inner-light mysticism, at the top, to unclean things, not worthy of mention in the same breath, at the bottom. In my poor opinion, the importance of these manifestations is often greatly over-estimated. The extant forms of Supernaturalism have deep roots in human nature, and will undoubtedly die hard; but, in these latter days, they have to cope with an enemy whose full strength is only just beginning to be put out, and whose forces, gathering strength year by year, are hemming them round on every side. This enemy is Science, in the acceptation of systematised natural knowledge, which, during the last two centuries, has extended those methods of investigation, the worth of which is confirmed by daily appeal to Nature, to every region in which the Supernatural has hitherto been recognised.

When scientific historical criticism reduced the annals of heroic Greece and of regal Rome to the level of fables; when the unity of authorship of the *Iliad* was successfully assailed by scientific literary [33] criticism; when scientific physical criticism, after exploding the geocentric theory of the universe and reducing the solar system itself to one of millions of groups of like cosmic specks, circling, at unimaginable distances from one another through infinite space, showed the supernaturalistic theories of the duration of the earth and of life upon it, to be as inadequate as those of its relative dimensions and importance had been; it needed no prophetic gift to see that, sooner or later, the Jewish and the early Christian records would be treated in the same manner; that the authorship of the Hexateuch and of the Gospels would be as severely tested; and that the evidenoe in favour of the veracity of many of the statements found in the Scriptures would have to be strong indeed, if they were to be opposed to the conclusions of physical science. In point of fact, so far as I can discover, no one competent to judge of the evidential strength of these conclusions, ventures now to say that the biblical account of the creation and of the deluge are true in the natural sense of the words of the narratives. The most modern Reconcilers venture upon is to affirm, that some quite different sense may be put upon the words; and that this non-natural sense may, with a little trouble, be manipulated into some sort of non-contradiction of scientific truth.

My purpose, in the essay (XVI.) which treats of the narrative of the Deluge, was to prove, by [34] physical criticism, that no such event as that described ever took place; to exhibit the untrustworthy character of the narrative demonstrated by literary criticism; and, finally, to account for its origin, by producing a form of those ancient legends of pagan Chaldæa, from which the biblical compilation is

manifestIy derived. I have yet to learn that the main propositions of this essay can be seriously challenged.

In the essays (II., III.) on the narrative of the Creation, I have endeavoured to controvert the assertion that modern science supports, either the interpretation put upon it by Mr. Gladstone, or any interpretation which is compatible with the general sense of the narrative, quite apart from particular details. The first chapter of Genesis teaches the supernatural creation of the present forms of life; modern science teaches that they have come about by evolution. The first chapter of Genesis teaches the successive origin–firstly, of all the plants, secondly, of all the aquatic and aerial animals, thirdly, of all the terrestrial animals, which now exist–during distinct intervals of time; modern science teaches that, throughout all the duration of an immensely long past, so far as we have any adequate knowledge of it (that is as far back as the Silurian epoch), plants, aquatic, aerial, and terrestrial animals have co-existed; that the earliest known are unlike those which at present exist; and that the modern species have [35] come into existence as the last terms of a series, the members of which have appeared one after another. Thus, far from confirming the account in Genesis, the results of modern science, so far as they go, are in principle, as in detail, hopelessly discordant with it.

Yet, if the pretensions to infallibility set up, not by the ancient Hebrew writings themselves, but by the ecclesiastical champions and friends from whom they may well pray to be delivered, thus shatter themselves against the rock of natural knowledge, in respect of the two most important of all events, the origin of things and the palingenesis of terrestrial life, what historical credit dare any serious thinker attach to the narratives of the fabrication of Eve, of the Fall, of the commerce between the *Bene Elohim* and the daughters of men, which lie between the creational and the diluvial legends? And, if these are to lose all historical worth, what becomes of the infallibility of those who, according to the later Scriptures, have accepted them, argued from them, and staked far-reaching dogmatic conclusions upon their historical accuracy?

It is the merest ostrich policy for contemporary ecclesiasticism to try to hide its Hexateuchal head–in the hope that the inseparable connection of its body with pre-Abrahamic legends may be overlooked. The question will still be asked, if the first nine chapters of the Pentateuch are [36] unhistorical, how is the historical accuracy of the remainder to be guaranteed? What more intrinsic claim has the story of the Exodus than that of the Deluge, to belief? If God did not walk in the Garden of Eden, how can we be assured that he spoke from Sinai?

In some other of the following essays (IX., X., Xl, XII., XIV., XV.) I have endeavoured to show that sober and well-founded physical and literary criticism plays no less havoc with the doctrine that the canonical scriptures of the New Testament "declare incontrovertibly the actual historical truth in all records." We are told that the Gospels contain a true revelation of the spiritual world–a proposition which, in one sense of the word "spiritual," I should not think it necessary to dispute. But, when it is taken to signify that everything we are told about the world of spirits in these books is infallibly true; that we are bound to accept the demonology which constitutes an inseparable part of their teaching; and to profess belief in a Supernaturalism as gross as that of any primitive people–it is at any rate permissible to ask why? Science may be unable to define the limits of possibility, but it cannot escape

from the moral obligation to weigh the evidence in favour of any alleged wonderful occurrence; and I have endeavoured to show that the evidence for the Gadarene miracle [37] is altogether worthless. We have simply three, partially discrepant, versions of a story, about the primitive form, the origin, and the authority for which we know absolutely nothing. But the evidence in favour of the Gadarene miracle is as good as that for any other.

Elsewhere, I have pointed out that it is utterly beside the mark to declaim against these conclusions on the ground of their asserted tendency to deprive mankind of the consolations of the Christian faith, and to destroy the foundations of morality; still less to brand them with the question-begging vituperative appellation of "infidelity." The point is not whether they are wicked; but, whether, from the point of view of scientific method, they are irrefragably true. If they are, they will be accepted in time, whether they are wicked, or not wicked. Nature, so far as we have been able to attain to any insight into her ways, recks little about consolation and makes for righteousness by very round-about paths. And, at any rate, whatever may be possible for the man who puts his faith in scientific methods of ascertaining truth, and is accustomed to have that faith justified by daily experience, to be consciously false to his principle in any matter. But the number of such men, driven into the use of scientific methods of inquiry and taught to trust them, by their education, their daily pro[38]fessional and business needs, is increasing and will continually increase. The phraseology of Supernaturalism may remain on men's lips, but in practice they are Naturalists. The magistrate who listens with devout attention to the precept "Thou shalt not suffer a witch to live" on Sunday, on Monday, dismisses, as intrinsically absurd, a charge of bewitching a cow brought against some old woman; the superintendent of a lunatic asylum who substituted exorcism for rational modes of treatment would have but a short tenure of office; even parish clerks doubt the utility of prayers for rain, so long as the wind is in the east; and an outbreak of pestilence sends men, not to the churches, but to the drains. In spite of prayers for the success of our arms and *Te Deums* for victory, our real faith is in big battalions and keeping our powder dry; in knowledge of the science of warfare; in energy, courage, and discipline. In these, as in all other practical affairs, we act on the aphorism "*Laborare est orare* "; we admit that intel1igent work is the only acceptable worship; and that, whether there be a Supernature or not, our business is with Nature.

It is important to note that the principle of the scientific Naturalism of the latter half of the nineteenth century, in which the intellectual movement of the Renascence has culminated, and [39] which was first clearly formulated by Descartes, leads not to the denial of the existence of any Supernature; but simply to the denial of the validity of the evidence adduced in favour of this, or of that, extant form of Supernaturalism.[5]

Looking at the matter from the most rigidly scientific point of view, the assumption that, amidst the myriads of worlds scattered through endless space, there can be no intelligence, as much greater than man's as his is greater than a blackbeetle's; no being endowed with powers of influencing the course of nature as much greater than his, as his is greater than a snail's, seems to me not merely baseless, but impertinent. Without stepping beyond the analogy of that which is known, it is easy to people the cosmos with entities, in ascending scale, until we reach something practically indistinguishable from omnipotence, omnipresence, and omniscience. If our intelligence can, in some matters, surely reproduce

the past of thousands of years ago and anticipate the future, thousands of years hence, it is clearly within the limits of possibility that some greater intellect, even of the same order, may be able to mirror the whole past and the whole future; if the universe [40] is penetrated by a medium of such a nature that a magnetic needle on the earth answers to a commotion in the sun, an omnipresent agent is also conceivable; if our insignificant knowledge gives us some influence over events, practical omniscience may confer indefinably greater power. Finally, if evidence that a thing may be, were equivalent to proof that it is, analogy might justify the construction of a naturalistic theology and demonology not less wonderful than the current supernatural; just as it might justify the peopling of Mars, or of Jupiter, with living forms to which terrestrial biology offers no parallel. Until human life is longer and the duties of the present press less heavily, I do not think that wise men will occupy themselves with Jovian, or Martian, natural history; and they will probably agree to a verdict of "not proven" in respect of naturalistic theology, taking refuge in that agnostic confession, which appears to me to be the only position for people who object to say that they know what they are quite aware they do not know. As to the interests of morality, I am disposed to think that if mankind could be got to act up to this last principle in every relation of life, a reformation would be effected such as the world has not yet seen; an approximation to the millennium, such as no supernaturalistic religion has ever yet succeeded, or seems likely ever to succeed, in effecting,

[41] I have hitherto dwelt upon scientific Naturalism chiefly in its critical and destructive aspect. But the present incarnation of the spirit of the Renascence differs from its predecessor in the eighteenth century, in that it builds up, as well as pulls down.

That of which it has laid the foundation, of which it is already raising the superstructure, is the doctrine of evolution. But so many strange misconceptions are current about this doctrine–it is attacked on such false grounds by its enemies, and made to cover so much that is disputable by some of its friends, that I think it well to define as clearly as I can, what I do not and what I do understand by the doctrine. I have nothing to say to any "Philosophy of Evolution." Attempts to construct such a philosophy may be as useful, nay, even as admirable, as was the attempt of Descartes to get at a theory of the universe by the same *a priori* road; but, in my judgment, they are as premature. Nor, for this purpose, have I to do with any theory of the "Origin of Species," much as I value that which is known as the Darwinian theory. That the doctrine of natural selection presupposes evolution is quite true; but it is not true that evolution necessarily implies natural selection. In fact, evolution might conceivably have taken place without the development of groups possessing the characters of species.

[42] For me, the doctrine of evolution is no speculation, but a generalisation of certain facts, which may be observed by any one who will take the necessary trouble. These facts are those which are classed by biologists under the heads of Embryology and of Palæontology. Embryology proves that every higher form of individual life becomes what it is by a process of gradual differentiation from an extremely low form; palæontology proves, in some cases, and renders probable in all, that the oldest types of a group are the lowest; and that they have been followed by a gradual succession of more and more differentiated forms. It is simply a fact, that evolution of the individual animal and plant is taking place, as a natural process, in millions and millions of cases every day; it is a fact, that the species which have succeeded one another in the past, do, in many cases, present just those morphological relations, which

they must possess, if they had proceeded, one from the other, by all analogous process of evolution.

The alternative presented, therefore, is: either the forms of one and the same type–say, *e.g.*, that of the Horse tribe[6]–arose successively, but independently of one another, at intervals, during myriads of years; or, the later forms are modified [43] descendants of the earlier. And the latter supposition is so vastly more probable than the former, that rational men will adopt it, unless satisfactory evidence to the contrary can be produced. The objection sometimes put forward, that no one yet professes to have seen one species pass into another, comes oddly from those who believe that mankind are all descended from Adam. Has any one then yet seen the production of negroes from a white stock, or *vice versa*? Moreover, is it absolutely necessary to have watched every step of the progress of a planet, to be justified in concluding that it really does go round the sun? If so, astronomy is in a bad way.

I do not, for a moment, presume to suggest that some one, far better acquainted than I am with astronomy and physics; or that a master of the new chemistry, with its extraordinary revelations; or that a student of the development of human society, of language, and of religions, may not find a sufficient foundation for the doctrine of evolution in these several regions. On the contrary, I rejoice to see that scientific investigation, in all directions, is tending to the same result. And it may well be, that it is only my long occupation with biological matters that leads me to feel safer among them than anywhere else. Be that as it may, I take my stand on the facts of embryology and of palæontology; and I hold that our present knowledge of these facts is sufficiently thorough [44] and extensive to justify the assertion that all future philosophical and theological speculations will have to accommodate themselves to some such common body of established truths as the following:–

1. Plants and animals have existed on our planet for many hundred thousand, probably millions, of years. During this time, their forms, or species, have undergone a succession of changes, which eventually gave rise to the species which constitute the present living population of the earth. There is no evidence, nor any reason to suspect, that this secular process of evolution is other than a part of the ordinary course of nature; there is no more ground for imagining the occurrence of supernatural intervention, at any moment in the development of species in the past, than there is for supposing such intervention to take place, at any moment in the development of an individual animal or plant, at the present day.

2. At present, every individual animal or plant commences its existence as an organism of extremely simple anatomical structure; and it acquires all the complexity it ultimately possesses by gradual differentiation into parts of various structure and function. When a series of specific forms of the same type, extending over a long period of past time, is examined, the relation between the earlier and the later forms is analogous to that between earlier and later stages of indi[45]vidual development. Therefore, it is a probable conclusion that, if we could follow living beings back to their earlier states, we should find them to present forms similar to those of the individual germ, or, what comes to the same thing, of those lowest known organisms which stand upon the boundary line between plants and animals. At present, our knowledge of the ancient living world stops very far short of this point.

3. It is generally agreed, and there is certainly no evidence to the contrary, that all plants are devoid of consciousness; that they neither feel, desire, nor think. It is conceivable that the evolution of the primordial living substance should have taken place only along the plant line. In that case, the result might have been a wealth of vegetable life, as great, perhaps as varied, as at present, though certainly widely different from the present flora, in the evolution of which animals have played so great a part. But the living world thus constituted would be simply an admirable piece of unconscious machinery, the working out of which lay potentially in its primitive composition; pleasure and pain would have no place in it; it would be a veritable Garden of Eden without any tree of the knowledge of good and evil. The question of the moral government of such a world could no more be asked, than we could reasonably seek for a moral purpose in a kaleidoscope.

4. How far down the scale of animal life the [46] phenomena of consciousness are manifested, it is impossible to say. No one doubts their presence in his fellow-men; and, unless any strict Cartesians are left, no one doubts that mammals and birds are to be reckoned creatures that have feelings analogous to our smell, taste, sight, hearing, touch, pleasure, and pain. For my own part, I should be disposed to extend this analogical judgment a good deal further. On the other hand, if the lowest forms of plants are to be denied consciousness, I do not see on what ground it is to be ascribed to the lowest animals. I find it hard to believe that an infusory animalcule, a foraminifer, or a fresh-water polype is capable of feeling; and, in spite of Shakspere, I have doubts about the great sensitiveness of the "poor beetle that we tread upon." The question is equally perplexing when we turn to the stages of development of the individual. Granted a fowl feels; that the chick just hatched feels; that the chick when it chirps within the egg may possibly feel; what is to be said of it on the fifth day, when the bird is there, but with all its tissues nascent? Still more, on the first day, when it is nothing but a flat cellular disk? I certainly cannot bring myself to believe that this disk feels. Yet if it does not, there must be some time in the three weeks, between the first day and the day of hatching, when, as a concomitant, or a consequence, of the attainment by the brain of the chick of a certain stage [47] of structural evolution, consciousness makes its appearance. I have frequently expressed my incapacity to understand the nature of the relation between consciousness and a certain anatomical tissue, which is thus established by observation. But the fact remains that, so far as observation and experiment go, they teach us that the psychical phenomena are dependent on the physical.

In like manner, if fishes, insects, scorpions, and such animals as the pearly nautilus, possess feeling, then undoubtedly consciousness was present in the world as far back as the Silurian epoch. But, if the earliest animals were similar to our rhizopods and monads, there must have been some time, between the much earlier epoch in which they constituted the whole animal population and the Silurian, in which feeling dawned, in consequence of the organism having reached the stage of evolution on which it depends.

5. Consciousness has various forms, which may be manifested independently of one another. The feelings of light and colour, of sound, of touch, though so often associated with those of pleasure and pain, are, by nature, as entirely independent of them as is thinking. An animal devoid of the feelings of pleasure and of pain, may nevertheless exhibit all the effects of sensation and purposive action. Therefore, it would be a justifiable hypothesis that, long after organic [48] evolution had attained to consciousness, pleasure and pain were still absent. Such a world would be without either happiness or

misery; no act could be punished and none could be rewarded; and it could have no moral purpose.

6. Suppose, for argument's sake, that all mammals and birds are subjects of pleasure and pain. Then we may be certain that these forms of consciousness were in existence at the beginning of the Mesozoic epoch. From that time forth, pleasure has been distributed without reference to merit, and pain inflicted without reference to demerit, throughout all but a mere fraction of the higher animals. Moreover, the amount and the severity of the pain, no less than the variety and acuteness of the pleasure, have increased with every advance in the scale of evolution. As suffering came into the world, not in consequence of a fall, but of a rise, in the scale of being, so every further rise has brought more suffering. As the evidence stands, it would appear that the sort of brain which characterises the highest mammals and which, so far as we know, is the indispensable condition of the highest sensibility, did not come into existence before the Tertiary epoch. The primordial anthropoid was probably, in this respect, on much the same footing as his pithecoid kin. Like them he stood upon his "natural rights," gratified all his desires to the best of his ability, and was as incapable of either right or [49] wrong doing as they. It would be as absurd as in their case, to regard his pleasures, any more than theirs, as moral rewards, and his pains, any more than theirs, as moral punishments.

7. From the remotest ages of which we have any cognizance, death has been the natural and, apparently, the necessary concomitant of life. In our hypothetical world (3), inhabited by nothing but plants, death must have very early resulted from the struggle for existence: many of the crowd must have jostled one another out of the conditions on which life depends. The occurrence of death, as far back as we have any fossil record of life, however, needs not to be proved by such arguments; for, if there had been no death there would have been no fossil remains, such as the great majority of those we met with. Not only was there death in the world, as far as the record of life takes us; but, ever since mammals and birds have been preyed upon by carnivorous animals, there has been painful death, inflicted by mechanisms specially adapted for inflicting it.

8. Those who are acquainted with the closeness of the structural relations between the human organisation and that of the mammals which come nearest to him, on the one hand; and with the palæontological history of such animals as horses and dogs, on the other; will not be disposed to question the origin of man from forms which stand in the same sort of relation to *Homo* [50] *sapiens* as *Hipparion* does to *Equus.* I think it a conclusion, fully justified by analogy, that, sooner or later, we shall discover the remains of our less specialised primatic ancestors in the strata which have yielded the less specialised equine and canine quadrupeds. At present, fossil remains of men do not take us back further than the later part of the Quaternary epoch; and, as was to be expected, they do not differ more from existing men, than Quaternary horses differ from existing horses. Still earlier we find traces of man, in implements, such as are used by the ruder savages at the present day. Later, the remains of the palæolithic and neolithic conditions take us gradually from the savage state to the civilisations of Egypt and of Mycenæ; though the true chronological order of the remains actually discovered may be uncertain.

9. Much has yet to be learned, but, at present, natural knowledge affords no support to the notion that men have fallen from a higher to a lower state. On the contrary, everything points to a slow natural evolution; which, favoured by the surrounding conditions in such localities as the valleys of the Yang-

tse-kang, the Euphrates, and the Nile, reached a relatively high pitch, five or six thousand years ago; while, in many other regions, the savage condition has persisted down to our day. In all this vast lapse of time there is not a trace of the occurrence of any general [51] destruction of the human race; not the smallest indication that man has been treated on any other principles than the rest of the animal world.

10. The results of the process of evolution in the case of man, and in that of his more nearly allied contemporaries, have been marvellously different. Yet it is easy to see that small primitive differences of a certain order, must, in the long run, bring about a wide divergence of the human stock from the others. It is a reasonable supposition that, in the earliest human organisms, an improved brain, a voice more capable of modulation and articulation, limbs which lent themselves better to gesture, a more perfect hand, capable among other things of imitating form in plastic or other material, were combined with the curiosity, the mimetic tendency, the strong family affection of the next lower group; and that they were accompanied by exceptional length of life and a prolonged minority. The last two peculiarities are obviously calculated to strengthen the family organisation, and to give great weight to its educative influences. The potentiality of language, as the vocal symbol of thought lay in the faculty of modulating and articulating the voice. The potentiality of writing, as the visual symbol of thought, lay in the hand that could draw; and in the mimetic tendency, which, as we know, was gratified by drawing, as far back as [52] the days of Quaternary man. With speech, as the record, in tradition, of the experience of more than one generation; with writing as the record of that of any number of generations; the experience of the race, tested and corrected generation after generation, could be stored up and made the starting point for fresh progress. Having these perfectly natural factors of the evolutionary process in man before us, it seems unnecessary to go further a-field in search of others.

11. That the doctrine of evolution implies a former state of innocence of mankind is quite true; but, as I have remarked, it is the innocence of the ape and of the tiger, whose acts, however they may run counter to the principles of morality, it would be absurd to blame. The lust of the one and the ferocity of the other are as much provided for in their organisation, are as clear evidences of design, as any other features that can be named.

Observation and experiment upon the phenomena of society soon taught men that, in order to obtain the advantages of social existence, certain rules must be observed. Morality commenced with society. Society is possible only upon the condition that the members of it shall surrender more or less of their individual freedom of action. In primitive societies, individual selfishness is a centrifugal force of such intensity that it is [53] constantly bringing the social organisation to the verge of destruction. Hence the prominence of the positive rules of obedience to the elders; of standing by the family or the tribe in all emergencies; of fulfilling the religious rites, non-observance of which is conceived to damage it with the supernatural powers, belief in whose existence is one of the earliest products of human thought; and of the negative rules, which restrain each from meddling with the life or property of another.

12. The highest conceivable form of human society is that in which the desire to do what is best for the whole, dominates and limits the action of every member of that society. The more complex the social organisation the greater the number of acts from which each man must abstain, if he desires to do that which is best for all. Thus the progressive evolution of society means increasing restriction of individual

freedom in certain directions.

With the advance of civilisation, and the growth of cities and of nations by the coalescence of families and of tribes, the rules which constitute the common foundation of morality and of law became more numerous and complicated, and the temptations to break or evade many of them stronger. In the absence of a clear apprehension of the natural sanctions of these rules, a supernatural sanction was assumed; and imagin[54]ation supplied the motives which reason was supposed to be incompetent to furnish. Religion, at first independent of morality, gradually took morality under its protection; and the supernaturalists have ever since tried to persuade mankind that the existence of ethics is bound up with that of supernaturalism.

I am not of that opinion. But, whether it is correct or otherwise, it is very clear to me that, as Beelzebub is not to be cast out by the aid of Beelzebub, so morality is not to be established by immorality. It is, we are told, the special peculiarity of the devil that he was a liar from the beginning. If we set out in life with pretending to know that which we do not know; with professing to accept for proof evidence which we are well aware is inadequate; with wilfully shutting our eyes and our ears to facts which militate against this or that comfortable hypothesis; we are assuredly doing our best to deserve the same character.

I have not the presumption to imagine that, in spite of all my efforts, errors may not have crept into these propositions. But I am tolerably confident that time will prove them to be substantially correct. And if they are so, I confess I do not see how any extant supernaturalistic system can also claim exactness. That they are irreconcilable with the biblical cosmogony, [55] anthropology, and theodicy is obvious; but they are no less inconsistent with the sentimental Deism of the "Vicaire Savoyard" and his numerous modern progeny. It is as impossible, to my mind, to suppose that the evolutionary process was set going with full foreknowledge of the result and yet with what we should understand by a purely benevolent intention, as it is to imagine that the intention was purely malevolent. And the prevalence of dualistic theories from the earliest times to the present day–whether in the shape of the doctrine of the inherently evil nature of matter; of an Ahriman; of a hard and cruel Demiurge; of a diabolical "prince of this world," show how widely this difficulty has been felt.

Many seem to think that, when it is admitted that the ancient literature, contained in our Bibles, has no more claim to infallibility than any other ancient literature; when it is proved that the Israelites and their Christian successors accepted a great many supernaturalistic theories and legends which have no better foundation than those of heathenism, nothing remains to be done but to throw the Bible aside as so much waste paper.

I have always opposed this opinion. It appears to me that if there is anybody more objectionable than the orthodox Bibliolater it is the heterodox Philistine, who can discover in a literature which, in some respects, has no superior, nothing but [56] a subject for scoffing and an occasion for the display of his conceited ignorance of the debt he owes to former generations.

Twenty-two years ago I pleaded for the use of the Bible as an instrument of popular education, and I venture to repeat what I then said:

"Consider the great historical fact that, for three centuries, this book has been woven into the life of all that is best and noblest in English history; that it has become the national Epic of Britain and is as familiar to gentle and simple, from John o' Groat's House to Land's End, as Dante and Tasso once were to the Italians; that it is written in the noblest and purest English and abounds in exquisite beauties of mere literary form; and, finally, that it forbids the veriest hind, who never left his village, to be ignorant of the existence of other countries and other civilisations and of a great past, stretching back to the furthest limits of the oldest nations in the world. By the study of what other book could children be so much humanised and made to feel that each figure in that vast historical procession fills, like themselves, but a momentary space in the interval between the Eternities; and earns the blessings or the curses of all time, according to its effort to do good and hate evil, even as they also are earning their payment for their work?"[7]

[57] At the same time, I laid stress upon the necessity of placing such instruction in lay hands, in the hope and belief, that it would thus gradually accommodate itself to the coming changes of opinion; that the theology and the legend would drop more and more out of sight, while the perennially interesting historical, literary, and ethical contents would come more and more into view.

I may add yet another claim of the Bible to the respect and the attention of a democratic age. Throughout the history of the western world, the Scriptures, Jewish and Christian, have been the great instigators of revolt against the worst forms of clerical and political despotism. The Bible has been the *Magna Charta* of the poor and of the oppressed; down to modern times, no State has had a constitution in which the interests of the people are so largely taken into account, in which the duties, so much more than the privileges, of rulers are insisted upon, as that drawn up for Israel in Deuteronomy and in Leviticus; nowhere is the fundamental truth that the welfare of the State, in the long run, depends on the uprightness of the citizen so strongly laid down. Assuredly, the Bible talks no trash about the rights of man; but it insists on the equality of duties, on the liberty to bring about that righteousness which is somewhat different from struggling for "rights"; on the fraternity of taking thought for one's neighbour as for one's self.

[58] So far as such equality, liberty, and fraternity are included under the democratic principles which assume the same names, the Bible is the most democratic book in the world. As such it began, through the heretical sects, to undermine the clerico-political despotism of the middle ages, almost as soon as it was formed, in the eleventh century; Pope and King had as much as they could do to put down the Albigenses and the Waldenses in the twelfth and thirteenth centuries; the Lollards and the Hussites gave them still more trouble in the fourteenth and fifteenth; from the sixteenth century onward, the Protestant sects have favoured political freedom in proportion to the degree in which they have refused to acknowledge any ultimate authority save that of the Bible.

But the enormous influence which has thus been exerted by the Jewish and Christian Scriptures has had

no necessary connection with cosmogonies, demonologies, and miraculous interferences. Their strength lies in their appeals, not to the reason, but to the ethical sense. I do not say that even the highest biblical ideal is exclusive of others or needs no supplement. But I do believe that the human race is not yet, possibly may never be, in a position to dispense with it.

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[1] With a few exceptions, which are duly noted when they amount to more than verbal corrections.

[2] *Declaration on the Truth of Holy Scripture.* The *Times,* 18th December, 1891.

[3] Declaration, Article 10.

[4] Ego vero evangelio non crederem, nisi ecclesiæ Catholicæ me commoveret auctoritas.–*Contra Epistolam Manischæi,* cap v.

[5] I employ the words "Supernature" and "Supernatural" in their popular senses. For myself, I am bound to say that the term "Nature" covers the totality of that which is. The world of psychical phenomena appears to me to be as much part of "Nature" as the world of physical phenomena; and I am unable to perceive any justification for cutting the Universe into two halves, one natural and one supernatural.

[6] The general reader will find an admirably clear and concise statement of the evidence in this case, in Professor Flower's recently published work *The Horse: a Study in Natural History* .

[7] "The School Boards: What they Can do and what they May do," 1870. *Critiques and Addresses,* p. 51.

THE HUXLEY FILE

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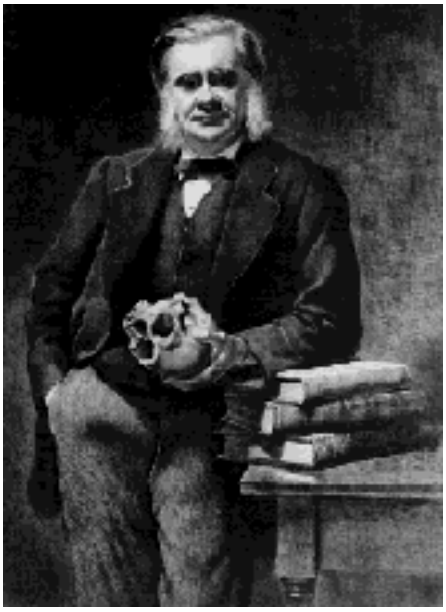

Scientific and Pseudo-Scientific Realism

The Nineteenth Century (April 1887)

Collected Essays V

[59] Next to undue precipitation in anticipating the results of pending investigations, the intellectual sin which is commonest and most hurtful to those who devote themselves to the increase of knowledge is the omission to profit by the experience of their predecessors recorded in the history of science and philosophy. It is true that, at the present day, there is more excuse than at any former time for such neglect. No small labour is needed to raise one's self to the level of the acquisitions already made; and able men, who have achieved thus much, know that, if they devote themselves body and soul to the increase of their store, and avoid looking back, with as much care as if the injunction laid on Lot and his family were binding upon them, such devotion is sure to be richly repaid by the joys of the discoverer and [60] the solace of fame, if not by rewards of a less elevated character.

So, following the advice of Francis Bacon, we refuse *inter mortuos quærere vivum;* we leave the past to bury its dead, and ignore our intellectual ancestry. Nor are we content with that. We follow the evil example set us, not only by Bacon but by almost all the men of the Renaissance, in pouring scorn upon the work of our immediate spiritual forefathers, the schoolmen of the Middle Ages. It is accepted as a truth which is indisputable, that, for seven or eight centuries, a long succession of able men–some of them of transcendent acuteness and encyclopædic knowledge–devoted laborious lives to the grave discussion of mere frivolities and the arduous pursuit of intellectual will-o'-the-wisps. To say nothing of a little modesty, a little impartial pondering over personal experience might suggest a doubt as to the adequacy of this short and easy method of dealing with a large chapter of the history of the human mind. Even an acquaintance with popular literature which had extended so far as to include that part of the contributions of Sam Slick which contains his weighty aphorism that "there is a great deal of human nature in all mankind," might raise a doubt whether, after all, the men of that epoch, who, take them all round, were endowed with wisdom and folly in much the same proportion as ourselves, were likely to [61] display nothing better than the qualities of energetic idiots, when they devoted their faculties to the elucidation of problems which were to them, and indeed are to us, the most serious which life has to offer. Speaking for myself, the longer I live the more I am disposed to think that there is much less either of pure folly, or of pure wickedness, in the world than is commonly supposed. It may be doubted if any sane man ever said to himself, "Evil, be thou my good," and have never yet had the good fortune to meet with a perfect fool. When I have brought to the inquiry the patience and long-suffering which become a scientific investigator, the most promising specimens have turned out to have a good deal to say for themselves from their own point of view. And, sometimes, calm reflection has taught the humiliating lesson, that their point of view was not so different from my own as I had fondly imagined. Comprehension is more than half-way to sympathy, here as elsewhere.

If we turn our attention to scholastic philosophy in the frame of mind suggested by these prefatory

remarks, it assumes a very different character from that which it bears in general estimation. No doubt it is surrounded by a dense thicket of thorny logomachies and obscured by the dust-clouds of a barbarous and perplexing terminology. But suppose that, undeterred by much grime and [62] by many scratches, the explorer has toiled through this jungle, he comes to an open country which is amazingly like his dear native land. The hills which he has to climb, the ravines he has to avoid, look very much the same; there is the same infinite space above, and the same abyss of the unknown below; the means of travelling are the same, and the goal is the same.

That goal for the schoolmen, as for us, is the settlement of the question how far the universe is the manifestation of a rational order; in other words, how far logical deduction from indisputable premisses will account for that which has happened and does happen. That was the object of scholasticism, and, so far as I am aware, the object of modern science may be expressed in the same terms. In pursuit of this end, modern science takes into account all the phenomena of the universe which are brought to our knowledge by observation or by experiment. It admits that there are two worlds to be considered, the one physical and the other psychical; and that though there is a most intimate relation and interconnection between the two, the bridge from one to the other has yet to be found; that their phenomena run, not in one series, but along two parallel lines.

To the schoolmen the duality of the universe appeared under a different aspect. How this came about will not be intelligible unless we clearly apprehend the fact that they did really [63] believe in dogmatic Christianity as it was formulated by the Roman Church. They did not give a mere dull assent to anything the Church told them on Sundays, and ignore her teachings for the rest of the week; but they lived and moved and had their being in that supersensible theological world which was created, or rather grew up, during the first four centuries of our reckoning, and which occupied their thoughts far more than the sensible world in which their earthly lot was cast.

For the most part, we learn history from the colourless compendiums or partisan briefs of mere scholars, who have too little acquaintance with practical life, and too little insight into speculative problems, to understand that about which they write. In historical science, as in all sciences which have to do with concrete phenomena, laboratory practice is indispensable; and the laboratory practice of historical science is afforded, on the one hand, by active social and political life, and, on the other, by the study of those tendencies and operations of the mind which embody themselves in philosophical and theological systems. Thucydides and Tacitus, and, to come nearer our own time, Hume and Grote, were men of affairs, and had acquired, by direct contact with social and political history in the making, the secret of understanding how such history is made. Our notions of the intellectual history of the [64] middle ages are, unfortunately, too often derived from writers who have never seriously grappled with philosophical and theological problems: and hence that strange myth of a millennium of moonshine to which I have adverted.

However, no very profound study of the works of contemporary writers who, without devoting themselves specially to theology or philosophy, were learned and enlightened–such men, for example, as Eginhard or Dante–is necessary to convince one's self, that, for them, the world of the theologian was an ever-present and awful reality. From the centre of that world, the Divine Trinity, surrounded by a

hierarchy of angels and saints, contemplated and governed the insignificant sensible world in which the inferior spirits of men, burdened with the debasement of their material embodiment and continually solicited to their perdition by a no less numerous and almost as powerful hierarchy of devils, were constantly struggling on the edge of the pit of everlasting damnation.[1]

[65] The men of the middle ages believed that through the Scriptures, the traditions of the Fathers, and the authority of the Church, they were in possession of far more, and more trustworthy, information with respect to the nature and order of things in the theological world than they had in regard to the nature and order of things in the sensible world. And, if the two sources of information came into conflict, so much the worse for the sensible world, which, after all, was more or less under the dominion of Satan. Let us suppose that a telescope powerful enough to show us what is going on in the nebula of the sword of Orion, should reveal a world in which stones fell upwards, parallel lines met, and the fourth dimension of space was quite obvious. Men of science would have only two alternatives before them. Either the terrestrial and the nebular facts must be brought into harmony by such feats of subtle sophistry as the human mind is always [66] capable of performing when driven into a corner; or science must throw down its arms in despair, and commit suicide, either by the admission that the universe is, after all, irrational, inasmuch as that which is truth in one corner of it is absurdity in another, or by a declaration of incompetency.

In the middle ages, the labours of those great men who endeavoured to reconcile the system of thought which started from the data of pure reason, with that which started from the data of Roman theology, produced the system of thought which is known as scholastic philosophy; the alternative of surrender and suicide is exemplified by Avicenna and his followers when they declared that that which is true in theology may be false in philosophy, and *vice versa* ; and by Sanchez in his famous defence of the thesis "*Quod nil scitu.*"

To those who deny the validity of one of the primary assumptions of the disputants–who decline, on the ground of the utter insufficiency of the evidence, to put faith in the reality of that other world, the geography and the inhabitants of which are so confidently described in the so-called[2] Christianity of Catholicism–the long and bitter contest, which engaged the best intellects for so [67] many centuries, may seem a terrible illustration of the wasteful way in which the struggle for existence is carried on in the world of thought, no less than in that of matter. But there is a more cheerful mode of looking at the history of scholasticism. It ground and sharpened the dialectic implements of our race as perhaps nothing but discussions, in the result of which men thought their eternal, no less than their temporal, interests were at stake, could have done. When a logical blunder may ensure combustion, not only in the next world but in this, the construction of syllogisms acquires a peculiar interest. Moreover, the schools kept the thinking faculty alive and active, when the disturbed state of civil life, the mephitic atmosphere engendered by the dominant ecclesiasticism, and the almost total neglect of natural knowledge, might well have stifled it. And, finally, it should be remembered that scholasticism really did thresh out pretty effectually certain problems which have presented themselves to mankind ever since they began to think, and which, I suppose, will present themselves so long as they continue to think. Consider, for example, the controversy of the Realists and the Nominalists, which was carried on with varying

fortunes, and under various names, from the time of Scotus Erigena to the end of the scholastic period. Has it now a merely antiquarian interest? Has Nominalism, in any of its modifications, so com[68] pletely won the day that Realism may be regarded as dead and buried without hope of resurrection? Many people seem to think so, but it appears to me that, without taking Catholic philosophy into consideration, one has not to look about far to find evidence that Realism is still to the fore, and indeed extremely lively.[3]

The other day I happened to meet with a report of a sermon recently preached in St. Paul's Cathedral. From internal evidence I am inclined to think that the report is substantially correct. But as I have not the slightest intention of finding fault with the eminent theologian and eloquent preacher to whom the discourse is attributed, for employment of scientific language in a manner for which he could find only too many scientific precedents, the accuracy of the report in detail is not to the purpose. I may safely take it as the embodiment of views which are thought to be [69] quite in accordance with science by many excellent, instructed, and intelligent people.

"The preacher further contended that it was yet more difficult to realise that our earthly home would become the scene of a vast physical catastrophe. Imagination recoils from the idea that the course of nature–the phrase helps to disguise the truth–so unvarying and regular, the ordered sequence of movement and life should suddenly cease. Imagination looks more reasonable when it assumes the air of scientific reason. Physical law, it says, will prevent the occurrence of catastrophes only anticipated by an apostle in an unscientific age. Might not there, however, be a suspension of a lower law by the intervention of a higher? Thus every time we lifted our arms we defied the laws of gravitation, and in railways and steamboats powerful laws were held in check by others. The flood and the destruction of Sodom and Gomorrah were brought about by the operations of existing laws, and may it not be that in His illimitable universe there are more important laws than those which surround our puny life–moral and not merely physical forces? Is it inconceivable that the day will come when these royal and ultimate laws shall wreck the natural order of things which seems so stable and so fair? Earthquakes were not things of remote antiquity, as an island off Italy, the Eastern Archipelago, Greece, and Chicago bore witness.... In presence of a great earthquake men feel how powerless they are, and their very knowledge adds to their weakness. The end of human probation, the final dissolution of organised society, and the destruction of man's home on the surface of the globe, were none of them violently contrary to our present experience, but only the extension of present facts. The presentiment of death was common; there were felt to be many things which threatened the existence of society; and as our globe was a ball of fire, at any moment the pent-up forces which surge and boil beneath our feet might be poured out. ("Pall Mall Gazette," December 6, 1886)."

The preacher appears to entertain the notion [70] that the occurrence of a "catastrophe"[4] involves a breach of the present order of nature–that it is an event incompatible with the physical laws which at present obtain. He seems to be of opinion that "scientific reason" lends its authority to the imaginative supposition that physical law will prevent the occurrence of the "catastrophes" anticipated by an unscientific apostle.

Scientific reason, like Homer, sometimes nods; but I am not aware that it has ever dreamed dreams of this sort. The fundamental axiom of scientific thought is that there is not, never has been, and never will be, any disorder in nature. The admission of the occurrence of any event which was not the logical

consequence of the immediately antecedent events, according to these definite, ascertained, or unascertained rules which we call the "laws of nature," would be an act of self-destruction on the part of science.

"Catastrophe" is a relative conception. For ourselves it means an event which brings about very terrible consequences to man, or impresses his mind by its magnitude relatively to him. But events which are quite in the natural order of things to us, may be frightful catastrophes to other sentient beings. Surely no interruption of the [71] order of nature is involved if, in the course of descending through an Alpine pine-wood, I jump upon an anthill and in a moment wreck a whole city and destroy a hundred thousand of its inhabitants. To the ants the catastrophe is worse than the earthquake of Lisbon. To me it is the natural and necessary consequence of the laws of matter in motion. A redistribution of energy has taken place, which is perfectly in accordance with natural order, however unpleasant its effects may be to the ants.

Imagination, inspired by scientific reason, and not merely assuming the airs thereof, as it unfortunately too often does in the pulpit, so far from having any right to repudiate catastrophes and deny the possibility of the cessation of motion and life, easily finds justification for the exactly contrary course. Kant in his famous "Theory of the Heavens" declares the end of the world and its reduction to a formless condition to be a necessary consequence of the causes to which it owes its origin and continuance. And, as to catastrophes of prodigious magnitude and frequent occurrence, they were the favourite *asylum ignorantiæ* of geologists, not a quarter of a century ago. If modern geology is becoming more and more disinclined to call in catastrophes to its aid, it is not because of any *a priori* difficulty in reconciling the occurrence of such events with the universality of order, but because the *a posteriori* evidence of [72] the occurrence of events of this character in past times has more or less completely broken down.

It is, to say the least, highly probable that this earth is a mass of extremely hot matter, invested by a cooled crust, through which the hot interior still continues to cool, though with extreme slowness. It is no less probable that the faults and dislocations, the foldings and fractures, everywhere visible in the stratified crust, its large and slow movements through miles of elevation and depression, and its small and rapid movements which give rise to the innumerable perceived and unperceived earthquakes which are constantly occurring, are due to the shrinkage of the crust on its cooling and contracting nucleus.

Without going beyond the range of fair scientific analogy, conditions are easily conceivable which should render the loss of heat far more rapid than it is at present; and such an occurrence would be just as much in accordance with ascertained laws of nature, as the more rapid cooling of a red-hot bar, when it is thrust into cold water, than when it remains in the air. But much more rapid cooling might entail a shifting and re-arrangement of the parts of the crust of the earth on a scale of unprecedented magnitude, and bring about "catastrophes" to which the earthquake of Lisbon is but a trifle. It is conceivable that man and his works and all the higher forms of animal life should be utterly destroyed; that mountain [73] regions should be converted into ocean depths and the floor of oceans raised into mountains; and the earth become a scene of horror which even the lurid fancy of the writer of the Apocalypse would fail to portray. And yet, to the eye of science, there would be no more disorder here than in the sabbatical peace of a summer sea. Not a link in the chain of natural causes and effects would be broken, nowhere would there be the slightest indication of the "suspension of a lower law by a higher." If a sober

scientific thinker is inclined to put little faith in the wild vaticinations of universal ruin which, in a less saintly person than the seer of Patmos, might seem to be dictated by the fury of a revengeful fanatic, rather than by the spirit of the teacher who bid men love their enemies, it is not on the ground that they contradict scientific principles; but because the evidence of their scientific value does not fulfil the conditions on which weight is attached to evidence. The imagination which supposes that it does, simply does not "assume the air of scientific reason."

I repeat that, if imagination is used within the limits laid down by science, disorder is unimaginable. If a being endowed with perfect intellectual and æsthetic faculties, but devoid of the capacity for suffering pain, either physical or moral, were to devote his utmost powers to the investigation of nature, the universe would seem to him to be a [74] sort of kaleidoscope, in which, at every successive moment of time, a new arrangement of parts of exquisite beauty and symmetry would present itself; and each of them would show itself to be the logical consequence of the preceding arrangement, under the conditions which we call the laws of nature. Such a spectator might well be filled with that *Amor intellectualis Dei*, the beatific vision of the *vita contemplativa*, which some of the greatest thinkers of all ages, Aristotle, Aquinas, Spinoza, have regarded as the only conceivable eternal felicity; and the vision of illimitable suffering, as if sensitive beings were unregarded animalcules which had got between the bits of glass of the kaleidoscope, which mars the prospect to us poor mortals, in no wise alters the fact that order is lord of all, and disorder only a name for that part of the order which gives us pain.

The other fallacious employment of the names of scientific conceptions which pervades the preacher's utterance, brings me back to the proper topic of the present essay. It is the use of the word "law" as if it denoted a thing–as if a "law of nature," as science understands it, were a being endowed with certain powers, in virtue of which the phenomena expressed by that law are brought about. The preacher asks, "Might not there be a suspension of a lower law by the intervention of higher?" He tells us that every time we lift our arms we defy the law of gravitation. He asks [75] whether some day certain "royal and ultimate laws" may not come and "wreck" those laws which are at present, it would appear, acting as nature's police. It is evident, from these expressions, that "laws," in the mind of the preacher, are entities having an objective existence in a graduated hierarchy. And it would appear that the "royal laws" are by no means to be regarded as constitutional royalties: at any moment, they may, like Eastern despots, descend in wrath among the middle-class and plebeian laws, which have hitherto done the drudgery of the world's work, and, to use phraseology not unknown in our seats of learning–"make hay" of their belongings. Or perhaps a still more familiar analogy has suggested this singular theory; and it is thought that high laws may "suspend" low laws, as a bishop may suspend a curate.

Far be it from me to controvert these views, if any one likes to hold them. All I wish to remark is that such a conception of the nature of "laws" has nothing to do with modern science. It is scholastic realism–realism as intense and unmitigated as that of Scotus Erigena a thousand years ago. The essence of such realism is that it maintains the objective existence of universals, or, as we call them nowadays, general propositions. It affirms, for example, that "man" is a real thing, apart from individual men, having its existence, not in the sensible, but in the intelligible [76] world, and clothing itself with the accidents of sense to make the Jack and Tom and Harry whom we know. Strange as such a notion may appear to modern scientific thought, it really pervades ordinary language. There are few people who

would, at once, hesitate to admit that colour, for example, exists apart from the mind which conceives the idea of colour. They hold it to be something which resides in the coloured object; and so far they are as much Realists as if they had sat at Plato's feet. Reflection on the facts of the case must, I imagine, convince every one that "colour" is–not a mere name, which was the extreme Nominalist position–but a name for that group of states of feeling which we call blue, red, yellow, and so on, and which we believe to be caused by luminiferous vibrations which have not the slightest resemblance to colour; while these again are set afoot by states of the body to which we ascribe colour, but which are equally devoid of likeness to colour.

In the same way, a law of nature, in the scientific sense, is the product of a mental operation upon the facts of nature which come under our observation, and has no more existence outside the mind than colour has. The law of gravitation is a statement of the manner in which experience shows that bodies, which are free to move, do, in fact, move towards one another. But the other facts of observation, that bodies are not always [77] moving in this fashion, and sometimes move in a contrary direction, are implied in the words "free to move." If it is a law of nature that bodies tend to move towards one another in a certain way; it is another and no less true law of nature that, if bodies are not free to move as they tend to do, either in consequence of an obstacle, or of a contrary impulse from some other source of energy than that to which we give the name of gravitation, they either stop still, or go another way.

Scientifically speaking, it is the acme of absurdity to talk of a man defying the law of gravitation when he lifts his arm. The general store of energy in the universe working through terrestrial matter is doubtless tending to bring the man's arm down; but the particular fraction of that energy which is working through certain of his nervous and muscular organs is tending to drive it up, and more energy being expended on the arm in the upward than in the downward direction, the arm goes up accordingly. But the law of gravitation is no more defied, in this case, than when a grocer throws so much sugar into the empty pan of his scales that the one which contains the weight kicks the beam.

The tenacity of the wonderful fallacy that the laws of nature are agents, instead of being, as they really are, a mere record of experience, upon which we base our interpretations of that which does happen, and our anticipation of that which [78] will happen, is an interesting psychological fact; and would be unintelligible if the tendency of the human mind towards realism were less strong.

Even at the present day, and in the writings of men who would at once repudiate scholastic realism in any form, "law" is often inadvertently employed in the sense of cause, just as, in common life, a man will say that he is compelled by the law to do so and so, when, in point of fact, all he means is that the law orders him to do it, and tells him what will happen if he does not do it. We commonly hear of bodies falling to the ground by reason of the law of gravitation, whereas that law is simply the record of the fact that, according to all experience, they have so fallen (when free to move), and of the grounds of a reasonable expectation that they will so fall. If it should be worth anybody's while to seek for examples of such misuse of language on my own part, I am not at all sure he might not succeed, though I have usually been on my guard against such looseness of expression. If I am guilty, I do penance beforehand, and only hope that I may thereby deter others from committing the like fault. And I venture on this personal observation by way of showing that I have no wish to bear hardly on the preacher for falling

into an error for which he might find good precedents. But it is one of those errors which, in the case of a person engaged [79] in scientific pursuits, do little harm, because it is corrected as soon as its consequences become obvious; while those who know physical science only by name are, as has been seen, easily led to build a mighty fabric of unrealities on this fundamental fallacy. In fact, the habitual use of the word "law," in the sense of an active thing, is almost a mark of pseudo-science; it characterises the writings of those who have appropriated the forms of science without knowing anything of its substance.

There are two classes of these people: those who are ready to believe in any miracle so long as it is guaranteed by ecclesiastical authority; and those who are ready to believe in any miracle so long as it has some different guarantee. The believers in what are ordinarily called miracles–those who accept the miraculous narratives which they are taught to think are essential elements of religious doctrine–are in the one category; the spirit-rappers, table-turners, and all the other devotees of the occult sciences of our day are in the other: and, if they disagree in most things they agree in this, namely, that they ascribe to science a dictum that is not scientific; and that they endeavour to upset the dictum thus foisted on science by a realistic argument which is equally unscientific.

It is asserted, for example, that, on a particular occasion, water was turned into wine; and, on the [80] other hand, it is asserted that a man or a woman "levitated" to the ceiling, floated about there, and finally sailed out by the window. And it is assumed that the pardonable scepticism, with which most scientific men receive these statements, is due to the fact that they feel themselves justified in denying the possibility of any such metamorphosis of water, or of any such levitation, because such events are contrary to the laws of nature. So the question of the preacher is triumphantly put: How do you know that there are not "higher" laws of nature than your chemical and physical laws, and that these higher laws may not intervene and "wreck" the latter?

The plain answer to this question is, Why should anybody be called upon to say how he knows that which he does not know? You are assuming that laws are agents–efficient causes of that which happens–and that one law can interfere with another. To us, that assumption is as nonsensical as if you were to talk of a proposition of Euclid being the cause of the diagram which illustrates it, or of the integral calculus interfering with the rule of three. Your question really implies that we pretend to complete knowledge not only of all past and present phenomena, but of all that are possible in the future, and we leave all that sort of thing to the adepts of esoteric Buddhism. Our pretensions are infinitely more modest. We have succeeded in finding out [81] the rules of action of a little bit of the universe; we call these rules "laws of nature," not because anybody knows whether they bind nature or not, but because we find it is obligatory on us to take them into account, both as actors under nature, and as interpreters of nature. We have any quantity of genuine miracles of our own, and if you will furnish us with as good evidence of your miracles as we have of ours, we shall be quite happy to accept them and to amend our expression of the laws of nature in accordance with the new facts.

As to the particular cases adduced, we are so perfectly fair-minded as to be willing to help your case as far as we can. You are quite mistaken in supposing that anybody who is acquainted with the possibilities of physical science will undertake categorically to deny that water may be turned into wine. Many very

competent judges are already inclined to think that the bodies, which we have hitherto called elementary, are really composite arrangements of the particles of a uniform primitive matter. Supposing that view to be correct, there would be no more theoretical difficulty about turning water into alcohol, ethereal and colouring matters, than there is, at this present moment, any practical difficulty in working other such miracles; as when we turn sugar into alcohol, carbonic acid, glycerine, and succinic acid; or transmute gas-refuse into perfumes rarer than [82] musk and dyes richer than Tyrian purple. If the so-called "elements," oxygen and hydrogen, which compose water, are aggregates of the same ultimate particles, or physical units, as those which enter into the structure of the so-called element "carbon," it is obvious that alcohol and other substances, composed of carbon, hydrogen, and oxygen, may be produced by a rearrangement of some of the units of oxygen and hydrogen into the "element" carbon, and their synthesis with the rest of the oxygen and hydrogen.

Theoretically, therefore, we can have no sort of objection to your miracle. And our reply to the levitators is just the same. Why should not your friend "levitate"? Fish are said to rise and sink in the water by altering the volume of an internal air-receptacle; and there may be many ways science, as yet, knows nothing of, by which we, who live at the bottom of an ocean of air, may do the same thing. Dialectic gas and wind appear to be by no means wanting among you, and why should not long practice in pneumatic philosophy have resulted in the internal generation of something a thousand times rarer than hydrogen by which, in accordance with the most ordinary natural laws, you would not only rise to the ceiling and float there in quasi-angelic posture, but perhaps, as one of your feminine adepts is said to have done, flit swifter than train or telegram to "still-vexed Bermoothes," and twit Ariel, if he happens to be [83] there, for a sluggard? We have not the presumption to deny the possibility of anything you affirm; only, as our brethren are particular about evidence, do give us as much to go upon as may save us from being roared down by their inextinguishable laughter.

Enough of the realism which clings about "laws." There are plenty of other exemplifications of its vitality in modern science, but I will cite only one of them.

This is the conception of "vital force" which comes straight from the philosophy of Aristotle. It is a fundamental proposition of that philosophy that a natural object is composed of two constituents–the one its matter, conceived as inert or even, to a certain extent, opposed to orderly and purposive motion; the other its form, conceived as a quasi-spiritual something, containing or conditioning the actual activities of the body and the potentiality of its possible activities.

I am disposed to think that the prominence of this conception in Aristotle's theory of things arose from the circumstance that he was, to begin with and throughout his life, devoted to biological studies. In fact it is a notion which must force itself upon the mind of any one who studies biological phenomena, without reference to general physics, as they now stand. Everybody who observes the obvious phenomena of the development of a seed into a tree, or of an egg into an [84] animal, will note that a relatively formless mass of matter gradually grows, takes a definite shape and structure, and, finally, begins to perform actions which contribute towards a certain end, namely, the maintenance of the individual in the first place, and of the species in the second. Starting from the axiom that every event

has a cause, we have here the *causa finalis* manifested in the last set of phenomena, the *causa materialis* and *formalis* in the first, while the existence of a *causa efficiens* within the seed or egg and its product, is a corollary from the phenomena of growth and metamorphosis, which proceed in unbroken succession and make up the life of the animal or plant.

Thus, at starting, the egg or seed is matter having a "form" like all other material bodies. But this form has the peculiarity, in contradistinction to lower substantial "forms," that it is a power which constantly works towards an end by means of living organisation.

So far as I know, Leibnitz is the only philosopher (at the same time a man of science, in the modern sense, of the first rank) who has noted that the modern conception of Force, as a sort of atmosphere enveloping the particles of bodies, and having potential or actual activity, is simply a new name for the Aristotelian Form.[5] In modern biology, up till within quite recent times, the Aristotelian con[85]ception held undisputed sway; living matter was endowed with "vital force," and that accounted for everything. Whosoever was not satisfied with that explanation was treated to that very "plain argument"–"confound you eternally"–where with Lord Peter overcomes the doubts of his brothers in the "Tale of a Tub." "Materialist" was the mildest term applied to him–fortunate if he escaped pelting with "infidel" and "atheist" There may be scientific Rip Van Winkles about, who still hold by vital force; but among those biologists who have not been asleep for the last quarter of a century "vital force" no longer figures in the vocabulary of science. It is a patent survival of realism; the generalisation from experience that all living bodies exhibit certain activities of a definite character is made the basis of the notion that every living body contains an entity, "vital force," which is assumed to be the cause of those activities.

It is remarkable, in looking back, to notice to what an extent this and other survivals of scholastic realism arrested or, at any rate, impeded the application of sound scientific principles to the investigation of biological phenomena. When I was beginning to think about these matters, the scientific world was occasionally agitated by discussions respecting the nature of the "species" and "genera" of Naturalists, of a different order from the disputes of a later time. I think most [86] were agreed that a "species" was something which existed objectively, somehow or other, and had been created by a Divine fiat. As to the objective reality of genera, there was a good deal of difference of opinion. On the other hand, there were a few who could see no objective reality in anything but individuals, and looked upon both species and genera as hypostatised universals. As for myself, I seem to have unconsciously emulated William of Occam, inasmuch as almost the first public discourse I ever ventured upon, dealt with "Animal Individuality," and its tendency was to fight the Nominalist battle even in that quarter.

Realism appeared in still stranger forms at the time to which I refer. The community of plan which is observable in each great group of animals was hypostasised into a Platonic idea with the appropriate name of "archetype," and we were told, as a disciple of Philo-Judæus might have told us, that this realistic figment was "the archetypal light" by which Nature has been guided amidst the "wreck of worlds." So, again, another naturalist, who had no less earned a well-deserved reputation by his contributions to positive knowledge put forward a theory of the production of living things which, as nearly as the increase of knowledge allowed, was a reproduction of the doctrine inculcated by the Jewish

Cabbala.

Annexing the archetype notion, and carrying it to its full logical consequence, the author of this [87] theory conceived that the species of animals and plants were so many incarnations of the thoughts of God–material representations of Divine pleas–during the particular period of the world's history at which they existed. But, under the influence of the embryological and palæontological discoveries of modern times, which had already lent some scientific support to the revived ancient theories of cosmical evolution or emanation, the ingenious author of this speculation, while denying and repudiating the ordinary theory of evolution by successive modification of individuals, maintained and endeavoured to prove the occurrence of a progressive modification in the divine ideas of successive epochs.

On the foundation of a supposed elevation of organisation in the whole living population of any epoch, as compared with that of its predecessor, and a supposed complete difference in species between the populations of any two epochs (neither of which suppositions has stood the test of further inquiry), the author of this speculation based his conclusion that the Creator had, so to speak, improved upon his thoughts as time went on; and that, as each such amended scheme of creation came up, the embodiment of the earlier divine thoughts was swept away by a universal catastrophe, and an incarnation of the improved ideas took its place. Only after the last such "wreck" thus brought about, did the embodiment [88] of a divine thought, in the shape of the first man, make its appearance as the *ne plus ultra* of the cosmogonical process.

I imagine that Louis Agassiz, the genial backwoodsman of the science of my young days, who did more to open out new tracks in the scientific forest than most men, would have been much surprised to learn that he was preaching the doctrine of the Cabbala, pure and simple. According to this modification of Neoplatonism by contact with Hebrew speculation, the divine essence is unknowable–without form or attribute; but the interval between it and the world of sense is filled by intelligible entities, which are nothing but the familiar hypostatised abstractions of the realists. These have emanated, like immense waves of light, from the divine centre, and, as ten consecutive zones of Sephiroth, form the universe. The farther away from the centre, the more the primitive light wanes, until the periphery ends in those mere negations, darkness and evil, which are the essence of matter. On this, the divine agency transmitted through the Sephiroth operates after the fashion of the Aristotelian forms, and, at first, produces the lowest of a series of worlds. After a certain duration the primitive world is demolished and its fragments used up in making a better; and this process is repeated, until at length a final world, with man for its crown and finish, makes its appearance. It is needless to trace the process of retrogressive metamorphosis by which, through the agency of the Messiah, the steps of the process of evolution here sketched are retraced. Sufficient has been said to prove that the extremist realism current in the philosophy of the thirteenth century can be fully matched by the speculations of our own time.

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[1] There is no exaggeration in this brief and summary view of the Catholic cosmos. But it would be unfair to leave it to be supposed that the Reformation made any essential alteration, except perhaps for the worse, in that cosmology which called itself "Christian." The protagonist of the Reformation, from whom the whole of the

Evangelical sects are lineally descended, states the case with that plainness of speech, not to say brutality, which characterised him. Luther says that man is a beast of burden who only moves as his rider orders; sometimes God rides him, and sometimes Satan. "Sic voluntas humana in medio posita est, ceu jumentum; si insederit Deus, vult et vadit, quo vult Deus.... Si insederit Satan, vult et vadit, quo vult Satan; nec est in ejus arbitrio ad utrum sessorem currere, aut eum quærere, sed ipsi sessores certant ob ipsum obtinendum et possidendum" (*De Servo Arbitrio*, M. Lutheri Opera, ed. 1546, t. ii. p. 468). One may hear substantially the same doctrine preached in the parks and at street-corners by zealous volunteer missionaries of Evangelicism, any Sunday, in modern London. Why these doctrines, which are conspicuous by their absence in the four Gospels, should arrogate to themselves the title of Evangelical, in contradistinction to Catholic Christianity, may well perplex the impartial inquirer, who, if he were obliged to choose between the two, might naturally prefer that which leaves the poor beast of burden a little freedom of choice.

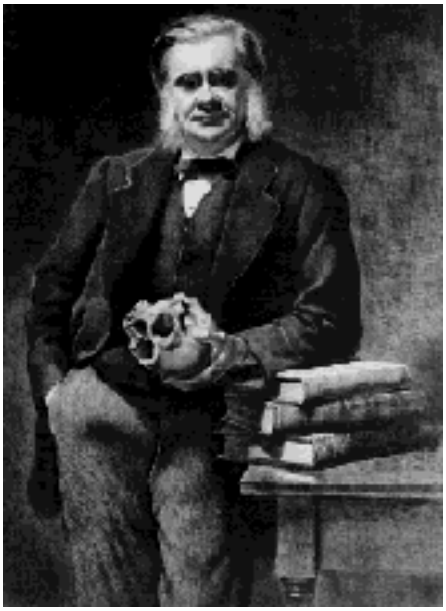
[2] I say "so-called" not by way of offence, but as a protest against the monstrous assumption that Catholic Christianity is explicitly or implicitly contained in any trustworthy record of the teaching of Jesus of Nazareth,

[3] It may be desirable to observe that, in modern times, the term "Realism" has acquired a signification wholly different from that which attached to it in the middle ages. We commonly use it as the contrary of Idealism. The Idealist holds that the phenomenal world has only a subjective existence, the Realist that it has an objective existence. I am not aware that any mediæval philosopher was an Idealist in the sense in which we apply the term to Berkeley. In fact, the cardinal defect of their speculations lies in their oversight of the considerations which lead to Idealism. If many of them regarded the material world as a negation, it was an active negation; not zero but a minus quantity.

[4] At any rate a catastrophe greater than the flood, which, as I observe with interest, is as calmly assumed by the preacher to be an historical event as if science had never had a word to say on that subject!

[5] "Les formes des anciens ou Entéléchies ne sont autre chose que les forces." (Leibnitz, *Lettre au Père Bouvet*, 1697).

THE HUXLEY FILE



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Science and Pseudo-Science

The Nineteenth Century (February 1887)

Collected Essays V

[90] In the opening sentences of a contribution to the last number of this Review,[1] the Duke of Argyll has favoured me with a lecture on the proprieties of controversy, to which I should be disposed to listen with more docility if his Grace's precepts appeared to me to be based upon rational principles, or if his example were more exemplary.

With respect to the latter point, the Duke has thought fit to entitle his article "Professor Huxley on Canon Liddon," and thus forces into prominence an element of personality, which those who read the paper which is the object of the Duke's animadversions will observe I have endeavoured, most carefully, to avoid. My criticisms dealt with a report of a sermon, published in a newspaper, and thereby addressed to all the world. Whether that sermon was preached by A or B was not a [91] matter of the smallest consequence; and I went out of my way to absolve the learned divine to whom the discourse was attributed, from the responsibility for statements which, for anything I knew to the contrary, might contain imperfect, or inaccurate, representations of his views. The assertion that I had the wish, or was beset, by any "temptation to attack" Canon Liddon is simply contrary to fact.

But suppose that if, instead of sedulously avoiding even the appearance of such attack, I had thought fit to take a different course; suppose that, after satisfying myself that the eminent clergyman whose name is paraded by the Duke of Argyll had really uttered the words attributed to him from the pulpit of St. Paul's, what right would any one have to find fault with my action on grounds either of justice, expediency, or good taste?

Establishment has its duties as well as its rights. The clergy of a State Church enjoy many advantages over those of unprivileged and unendowed religious persuasions; but they lie under a correlative responsibility to the State, and to every member of the body politic. I am not aware that any sacredness attaches to sermons. If preachers stray beyond the doctrinal limits set by lay lawyers, the Privy Council will see to it; and, if they think fit to use their pulpits for the promulgation of literary, or historical, or scientific [92] errors, it is not only the right, but the duty, of the humblest layman, who may happen to be better informed, to correct the evil effects of such perversion of the opportunities which the State affords them; and such misuse of the authority which its support lends them. Whatever else it may claim to be, in its relations with the State, the Established Church is a branch of the Civil Service; and, for those who repudiate the ecclesiastical authority of the clergy, they are merely civil servants, as much responsible to the English people for the proper performance of their duties as any others.

The Duke of Argyll tells us that the "work and calling" of the clergy prevent them from "pursuing disputation as others can." I wonder if his Grace ever reads the so-called "religious" newspapers. It is not

an occupation which I should commend to any one who wishes to employ his time profitably; but a very short devotion to this exercise will suffice to convince him that the "pursuit of disputation," carried to a degree of acrimony and vehemence unsurpassed in lay controversies, seems to be found quite compatible with the "work and calling" of a remarkably large number of the clergy.

Finally, it appears to me that nothing can be in worse taste than the assumption that a body of English gentlemen can, by any possibility, desire that immunity from criticism which the Duke of [93] Argyll claims for them. Nothing would be more personally offensive to me than the supposition that I shirked criticism, just or unjust, of any lecture I ever gave. I should be utterly ashamed of myself if, when I stood up as an instructor of others, I had not taken every pain to assure myself of the truth of that which I was about to say; and I should feel myself bound to be even more careful with a popular assembly, who would take me more or less on trust, than with an audience of competent and critical experts.

I decline to assume that the standard of morality, in these matters, is lower among the clergy than it is among scientific men. I refuse to think that the priest who stands up before a congregation, as the minister and interpreter of the Divinity, is less careful in his utterances, less ready to meet adverse comment, than the layman who comes before his audience, as the minister and interpreter of nature. Yet what should we think of the man of science who, when his ignorance or his carelessness was exposed, whined about the want of delicacy of his critics, or pleaded his "work and calling" as a reason for being let alone?

No man, nor any body of men, is good enough, or wise enough, to dispense with the tonic of criticism. Nothing has done more harm to the clergy than the practice, too common among laymen, of regarding them, when in the pulpit, as [94] a sort of chartered libertines, whose divagations are not to be taken seriously. And I am well assured that the distinguished divine, to whom the sermon is attributed, is the last person who would desire to avail himself of the dishonouring protection which has been superfluously thrown over him.

So much for the lecture on propriety. But the Duke of Argyll, to whom the hortatory style seems to come naturally, does me the honour to make my sayings the subjects of a series of other admonitions, some on philosophical, some on geological, some on biological topics. I can but rejoice that the Duke's authority in these matters is not always employed to show that I am ignorant of them; on the contrary, I meet with an amount of agreement, even of approbation, for which I proffer such gratitude as may be due, even if that gratitude is sometimes almost overshadowed by surprise.

I am unfeignedly astonished to find that the Duke of Argyll, who professes to intervene on behalf of the preacher, does really, like another Balaam, bless me altogether in respect of the main issue.

I denied the justice of the preacher's ascription to men of science of the doctrine that miracles are incredible, because they are violations of natural law; and the Duke of Argyll says that he believes my "denial to be well-founded. The [95] preacher was answering an objection which has now been generally abandoned." Either the preacher knew this or he did not know it. It seems to me, as a mere lay teacher,

to be a pity that the "great dome of St. Paul's" should have been made to "echo" (if so be that such stentorian effects were really produced) a statement which, admitting the first alternative, was unfair, and, admitting the second, was ignorant.[2]

Having thus sacrificed one half of the preacher's arguments, the Duke of Argyll proceeds to make equally short work with the other half. It appears that he fully accepts my position that the occurrence of those events, which the preacher speaks of as catastrophes, is no evidence of disorder, inasmuch as such catastrophes may be necessary occasional consequences of uniform changes. Whence I conclude, his Grace agrees with me, that the talk about royal laws "wrecking" [96] ordinary laws may be eloquent metaphor, but is also nonsense.

And now comes a further surprise. After having given these superfluous stabs to the slain body of the preacher's argument, my good ally remarks, with magnificent calmness: "So far, then, the preacher and the professor are at one." "Let them smoke the calumet." By all means: smoke would be the most appropriate symbol of this wonderful attempt to cover a retreat. After all, the Duke has come to bury the preacher, not to praise him; only he makes the funeral obsequies look as much like a triumphal procession as possible.

So far as the questions between the preacher and myself are concerned, then, I may feel happy. The authority of the Duke of Argyll is ranged on my side. But the Duke has raised a number of other questions, with respect to which I fear I shall have to dispense with his support–nay, even be compelled to differ from him as much, or more, than I have done about his Grace's new rendering of the "benefit of clergy."

In discussing catastrophes, the Duke indulges in statements, partly scientific, partly anecdotic, which appear to me to be somewhat misleading. We are told, to begin with, that Sir Charles Lyell's doctrine respecting the proper mode of interpreting the facts of geology (which is commonly called uniformitarianism) "does not hold [97] its head quite so high as it once did." That is great news indeed. But is it true? All I can say is that I am aware of nothing that has happened of late that can in any way justify it; and my opinion is, that the body of Lyell's doctrine, as laid down in that great work, "The Principles of Geology," whatever may have happened to its head, is a chief and permanent constituent of the foundations of geological science.

But this question cannot be advantageously discussed, unless we take some pains to discriminate between the essential part of the uniformitarian doctrine and its accessories; and it does not appear that the Duke of Argyll has carried his studies of geological philosophy so far as this point. For he defines uniformitarianism to be the assumption of the "extreme slowness and perfect continuity of all geological changes."

What "perfect continuity" may mean in this definition, I am by no means sure; but I can only imagine that it signifies the absence of any break in the course of natural order during the millions of years, the lapse of which is recorded by geological phenomena.

Is the Duke of Argyll prepared to say that any geologist of authority, at the present day, believes that there is the slightest evidence of the occurrence of supernatural intervention, during the long ages of which the monuments are preserved to us in the crust of the earth? And if he is not, [98] in what sense has this part of the uniformitarian doctrine, as he defines it, lowered its pretensions to represent scientific truth?

As to the "extreme slowness of all geological changes," it is simply a popular error to regard that as, in any wise, a fundamental and necessary dogma of uniformitarianism. It is extremely astonishing to me that any one who has carefully studied Lyell's great work can have so completely failed to appreciate its purport, which yet is "writ large" on the very title-page: "The Principles of Geology, being an attempt to explain the former changes of the earth's surface by reference to causes now in operation." The essence of Lyell's doctrine is here written so that those who run may read; and it has nothing to do with the quickness or slowness of the past changes of the earth's surface; except in so far as existing analogous changes may go on slowly, and therefore create a presumption in favour of the slowness of past changes.

With that epigrammatic force which characterises his style, Buffon wrote, nearly a hundred and fifty years ago, in his famous "Théorie de la Terre": "Pour juger de ce qui est arrivé, et même de ce qui arrivera, nous n'avons qu'à examiner ce qui arrive." The key of the past, as of the future, is to be sought in the present; and, only when known causes of change have been shown to be insufficient, have we any right to have recourse to [99] unknown causes. Geology is as much a historical science as archæology; and I apprehend that sound historical investigation rests upon this axiom. It underlay all Hutton's work and animated Lyell and Scope in their successful effort to revolutionise the geology of half a century ago.

There is no antagonism whatever, and there never was, between the belief in the views which had their chief and unwearied advocate in Lyell and the belief in the occurrence of catastrophes. The first edition of Lyell's "Principles," published in 1830, lies before me; and a large part of the first volume is occupied by an account of volcanic, seismic, and diluvial catastrophes which have occurred within the historical period. Moreover, the author, over and over again, expressly draws the attention of his readers to the consistency of catastrophes with his doctrine.

"Notwithstanding, therefore, that we have not witnessed within the last three thousand years the devastation by deluge of a large continent, yet, as we may predict the future occurrence of such catastrophes, we are authorised to regard them as part of the present order of nature, and they may be introduced into geological speculations respecting the past, provided that we do not imagine them to have been more frequent or general than we expect them to be in time to come" (vol. i. p 89).

Again:–

"If we regard each of the causes separately, which we know to be at present the most instrumental in remodelling the state of the surface, we shall find that we must expect each to be in action for thousands of years, without producing any extensive [100] alterations in the habitable surface, and then to give rise, during a very brief period, to important revolutions" (vol. ii. p. 161).[3]

Lyell quarrelled with the catastrophists then, by no means because they assumed that catastrophes occur and have occurred, but because they had got into the habit of calling on their god Catastrophe to help them, when they ought to have been putting their shoulders to the wheel of observation of the present course of nature, in order to help themselves out of their difficulties. And geological science has become what it is, chiefly because geologists have gradually accepted Lyell's doctrine and followed his precepts.

So far as I know anything about the matter, there is nothing that can be called proof, that the causes of geological phenomena operated more intensely or more rapidly, at any time between the older tertiary and the oldest palæozoic epochs than they have done between the older tertiary epoch and the present day. And if that is so, uniformitarianism, even as limited by Lyell,[4] has no [101] call to lower its crest. But if the facts were otherwise, the position Lyell took up remains impregnable. He did not say that the geological operations of nature were never more rapid, or more vast, than they are now; what he did maintain is the very different proposition that there is no good evidence of anything of the kind. And that proposition has not yet been shown to be incorrect.

I owe more than I can tell to the careful study of the "Principles of Geology" in my young days; and, long before the year 1856, my mind was familiar with the truth that "the doctrine of uniformity is not incompatible with great and sudden changes," which, as I have shown, is taught *totidem verbis* in that work. Even had it been possible for me to shut my eyes to the sense of what I had read in the "Principles," Whewell's "Philosophy of the Inductive Sciences," published in 1840, a work with which I was also tolerably familiar, must have opened them. For the always acute, if not always profound, author, in arguing against Lyell's uniformitarianism, ex[102]pressly points out that it does not in any way contravene the occurrence of catastrophes.

"With regard to such occurrences [earthquakes, deluges, etc.], terrible as they appear at the time, they may not much affect the average rate of chance: there may be a *cycle*, though an irregular one, of rapid and slow change: and if such cycles go on succeeding each other, we may still call the order of nature uniform, notwithstanding the periods of violence which it involves."[5]

The reader who has followed me through this brief chapter of the history of geological philosophy will probably find the following passage in the paper of the Duke of Argyll to be not a little remarkable:–

"Many years ago, when I had the honour of being President of the British Association,[6] I ventured to point out, in the presence and in the hearing of that most distinguished man [Sir C. Lyell] that the doctrine of uniformity was not incompatible with great and sudden changes, since cycles of these and other cycles of comparative rest might well be constituent parts of that uniformity which he asserted. Lyell did not object to this extended interpretation of his own doctrine, and indeed expressed to me his entire concurrence."

I should think he did; for, as I have shown, there was nothing in it that Lyell himself had not said, six-and-twenty years before, and enforced, three years before; and it is almost verbally identical with the view of uniformitarianism taken by Whewell, sixteen years before, in a work with which, one would

think, that any one who [103] undertakes to discuss the philosophy of science should be familiar.

Thirty years have elapsed since the beginner of 1856 persuaded himself that he enlightened the foremost geologist of his time, and one of the most acute and far-seeing men of science of any time, as to the scope of the doctrines which the veteran philosopher had grown gray in promulgating; and the Duke of Argyll's acquaintance with the literature of geology has not, even now, become sufficiently profound to dissipate that pleasant delusion.

If the Duke of Argyll's guidance in that branch of physical science, with which alone he has given evidence of any practical acquaintance, is thus unsafe, I may breathe more freely in setting my opinion against the authoritative deliverances of his Grace about matters which lie outside the province of geology.

And here the Duke's paper offers me such a wealth of opportunities that choice becomes embarrassing. I must bear in mind the good old adage, "Non multa sed multum." Tempting as it would be to follow the Duke through his labyrinthine misunderstandings of the ordinary terminology of philosophy, and to comment on the curious unintelligibility which hangs about his frequent outpourings of fervid language, limits of space oblige me to restrict myself to those points, the discussion of which may help to en[104] lighten the public in respect of matters of more importance than the competence of my Mentor for the task which he has undertaken.

I am not sure when the employment of the word Law, in the sense in which we speak of laws of nature, commenced, but examples of it may be found in the works of Bacon, Descartes, and Spinoza. Bacon employs "Law" as the equivalent of "Form," and I am inclined to think that he may be responsible for a good deal of the confusion that has subsequently arisen; but I am not aware that the term is used by other authorities, in the seventeenth and eighteenth centuries, in any other sense than that of "rule" or "definite order" of the coexistence of things or succession of events in nature. Descartes speaks of "règles, que je nomme les lois de la nature." Leibnitz says "loi ou règle générale," as if he considered the terms interchangeable.

The Duke of Argyll, however, affirms that the "law of gravitation" as put forth by Newton was something more than the statement of an observed order. He admits that Kepler's three laws "were an observed order of facts and nothing more." As to the law of gravitation, "it contains an element which Kepler's laws did not contain, even an element of causation, the recognition of which belongs to a higher category of intellectual conceptions than that which is concerned in the mere observation and record of separate and apparently [105] unconnected facts." There is hardly a line in these paragraphs which appears to me to be indisputable. But, to confine myself to the matter in hand, I cannot conceive that any one who had taken ordinary pains to acquaint himself with the real nature of either Kepler's or Newton's work could have written them. That the labours of Kepler, of all men in the world, should be called "mere observation and record," is truly wonderful. And any one who will look into the "Principia," or the "Optics," or the "Letters to Bentley," will see, even if he has no more special knowledge of the topics discussed than I have, that Newton over and over again insisted that he had nothing to do with

gravitation as a physical cause, and that when he used the terms attraction, force, and the like, he employed them, as he says, "*mathematicè*" and not "*physicè*."

"How these attractions [of gravity, magnetism, and electricity] may be performed, I do not here consider. What I call attraction may be performed by impulse or by some other means unknown to me. I use that word here to signify only in a general way any force by which bodies tend towards one another, whatever be the cause."[7]

According to my reading of the best authorities upon the history of science, Newton discovered neither gravitation, nor the law of gravitation; nor did he pretend to offer more than a conjecture as to the causation of gravitation. Moreover, his [106] assertion that the notion of a body acting where it is not, is one that no competent thinker could entertain, is antagonistic to the whole current conception of attractive and repulsive forces, and therefore of "the attractive force of gravitation." What then, was that labour of unsurpassed magnitude and excellence and of immortal influence which Newton did perform? In the first place, Newton defined the laws, rules, or observed order of the phenomena of motion, which come under our daily observation, with greater precision than had been before attained; and, by following out, with marvellous power and subtlety, the mathematical consequences of these rules, he almost created the modern science of pure mechanics. In the second place, applying exactly the same method to the explication of the facts of astronomy as that which was applied a century and a half later to the facts of geology by Lyell, he set himself to solve the following problem. Assuming that all bodies, free to move, tend to approach one another as the earth and the bodies on it do; assuming that the strength of that tendency is directly as the mass and inversely as the squares of the distances; assuming that the laws of motion, determined for terrestrial bodies, hold good throughout the universe; assuming that the planets and their satellites were created and placed at their observed mean distances, and that each received a certain impute from the Creator; [107] will the form of the orbits, the varying rates of motion of the planets, and the ratio between those rates and their distances from the sun, which must follow by mathematical reasoning from these premisses, agree with the order of facts determined by Kepler and others, or not?

Newton, employing mathematical methods which are the admiration of adepts, but which no one but himself appears to have been able to use with ease, not only answered this question in the affirmative, but stayed not his constructive genius before it had founded modern physical astronomy.

The historians of mechanical and of astronomical science appear to be agreed that he was the first person who clearly and distinctly put forth the hypothesis that the phenomena comprehended under the general name of "gravity" follow the same order throughout the universe, and that all material bodies exhibit these phenomena; so that, in this sense, the idea of universal gravitation may, doubtless, be properly ascribed to him.

Newton proved that the laws of Kepler were particular consequences of the laws of motion and the law of gravitation–in other words, the reason of the first lay in the two latter. But to talk of the law of gravitation alone as the reason of Kepler's laws, and still more as standing in any causal relation to Kepler's laws, is simply a misuse of language. It would really be interest[108]ing if the Duke of Argyll

would explain how he proposes to set about showing that the elliptical form of the orbits of the planets, the constant area described by the radius vector, and the proportionality of the squares of the periodic times to the cubes of the distances from the sun, are either caused by the "force of gravitation" or deducible from the "law of gravitation." I conceive that it would be about as apposite to say that the various compounds of nitrogen with oxygen are caused by chemical attraction and deducible from the atomic theory.

Newton assuredly lent no shadow of support to the modern pseudo-scientific philosophy which confounds laws with causes. I have not taken the trouble to trace out this commonest of fallacies to its first beginning; but I was familiar with it in full bloom, more than thirty years ago, in a work which had a great vogue in its day–the "Vestiges of the Natural History of Creation"–of which the first edition was published in 1844.

It is full of apt and forcible illustrations of pseudo-scientific realism. Consider, for example, this gem serene. When a boy who has climbed a tree loses his hold of the branch, "the law of gravitation unrelentingly pulls him to the ground, and then he is hurt," whereby the Almighty is quite relieved from any responsibility for the accident. Here is the "law of gravitation" [109] acting as a cause in a way quite in accordance with the Duke of Argyll's conception of it. In fact, in the mind of the author of the "Vestiges," "laws" are existences intermediate between the Creator and His works, like the "ideas" of the Platonisers or the Logos of the Alexandrians.[8] I may cite a passage which is quite in the vein of Philo:–

"We have seen powerful evidences that the construction of this globe and its associates; and, inferentially, that of all the other globes in space, was the result, not of any immediate or personal exertion on the part of the Deity, but of natural laws which are the expression of His will. What is to hinder our supposing that the organic creation is also a result of natural laws which are in like manner an expression of His will?" (p. 154, 1st edition).

And creation "operating by law" is constantly cited as relieving the Creator from trouble about insignificant details.

I am perplexed to picture to myself the state of mind which accepts these verbal juggleries. It is intelligible that the Creator should operate according to such rules as he might think fit to lay down for himself (and therefore according to law); but that would leave the operation of his will just as much a direct personal act as it would be under any other circumstances. I can also understand that (as in Leibnitz's caricature of Newton's views) the Creator might have made [110] the cosmical machine, and, after setting it going, have left it to itself till it needed repair. But then, by the supposition, his personal responsibility would have been involved in all that it did; just as much as a dynamiter is responsible for what happens, when he has set his machine going and left it to explode.

The only hypothesis which gives a sort of mad consistency to the Vestigiarian's views is the supposition that laws are a kind of angels or demiurgoi, who, being supplied with the great Architect's plan, were permitted to settle the details among themselves. Accepting this doctrine, the conception of royal laws and plebeian laws, and of those more than Homeric contests in which the big laws "wreck" the little

ones, becomes quite intelligible. And, in fact, the honour of the paternity of those remarkable ideas which come into full flower in the preacher's discourse, must, so far as my imperfect knowledge goes, be attributed to the author of the Vestiges."

But the author of the "Vestiges" is not the only writer who is responsible for the current pseudo-scientific mystifications which hang about the term "law." When I wrote my paper about "Scientific and Pseudo-Scientific Realism," I had not read a work by the Duke of Argyll, "The Reign of Law," which, I believe, has enjoyed, possibly still enjoys, a widespread popularity. But the vivacity of the Duke's attack led me to [111] think it possible that criticisms directed elsewhere might have come home to him. And, in fact, I find that the second chapter of the work in question, which is entitled "Law; its definitions," is, from my point of view, a sort of "summa" of pseudo-scientific philosophy. It will be worth while to examine it in some detail.

In the first place, it is to be noted that the author of the "Reign of Law" admits that "law," in many cases, means nothing more than the statement of the order in which facts occur, or, as he says, "an observed order of facts" (p. 66). But his appreciation of the value of accuracy of expression does not hinder him from adding, almost in the same breath, "In this sense the laws of nature are simply those facts of nature which recur according to rule" (p. 66). Thus "laws," which were rightly said to be the statement of an order of facts in one paragraph, are declared to be the facts themselves in the next.

We are next told that, though it may be customary and permissible to use "law" in the sense of a statement of the order of facts, this is a low use of the word; and, indeed, two pages farther on, the writer, flatly contradicting himself, altogether denies its admissibility.

"An observed order of facts, to be entitled to the rank of a law, must be an order so constant and uniform as to indicate necessity, and necessity can only arise out of the action of some compelling force" (p. 68).

[112] This is undoubtedly one of the most singular propositions that I have ever met with in a professedly scientific work, and its rarity is embellished by another direct self-contradiction which it implies. For on the preceding page (67), when the Duke of Argyll is speaking of the laws of Kepler, which he admits to be laws, and which are types of that which men of science understand by "laws," he says that they are "simply and purely an order of facts." Moreover, he adds: "A very large proportion of the laws of every science are laws of this kind and in this sense."

If, according to the Duke of Argyll's admission, law is understood, in this sense, thus widely and constantly by scientific authorities, where is the justification for his unqualified assertion that such statements of the observed order of facts are not "entitled to the rank" of laws?

But let us examine the consequences of the really interesting proposition I have just quoted. I presume that it is a law of nature that "a straight line is the shortest distance between two points." This law affirms the constant association of a certain fact of form with a certain fact of dimension. Whether the notion of necessity which attaches to it has an *a priori* or an *a posteriori* origin is a question not relevant

to the present discussion. But I would beg to be informed, if it is necessary, where is the "com[113] pelling force" out of which the necessity arises; and further, if it is not necessary, whether it loses the character of a law of nature?

I take it to be a law of nature, based on unexceptionable evidence, that the mass of matter remains unchanged, whatever chemical or other modifications it may undergo. This law is one of the foundations of chemistry. But it is by no means necessary. It is quite possible to imagine that the mass of matter should vary according to circumstances, as we know its weight does. Moreover, the determination of the "force" which makes mass constant (if there is any intelligibility in that form of words) would not, so far as I can see, confer any more validity on the law than it has now.

There is a law of nature, so well vouched by experience, that all mankind, from pure logicians in search of examples to parish sextons in search of fees, confide in it. This is the law that "all men are mortal." It is simply a statement of the observed order of facts that all men sooner or later die. I am not acquainted with any law of nature which is more "constant and uniform" than this. But will any one tell me that death is "necessary"? Certainly there is no *a priori* necessity in the case, for various men have been imagined to be immortal. And I should be glad to be informed of any "necessity" that can be deduced from biological considerations. It is [114] quite conceivable, as has recently been pointed out, that some of the lowest forms of life may be immortal, after a fashion. However this may be, I would further ask, supposing "all men are mortal" to be a real law of nature, where and what is that to which, with any propriety, the title of "compelling force" of the law can be given?

On page 69, the Duke of Argyll asserts that the law of gravitation "is a law in the sense, not merely of a rule, but of a cause." But this revival of the teaching of the "Vestiges" has already been examined and disposed of; and when the Duke of Argyll states that the "observed order" which Kepler had discovered was simply a necessary consequence of the force of "gravitation," I need not recapitulate the evidence which proves such a statement to be wholly fallacious. But it may be useful to say, once more, that, at this present moment, nobody knows anything about the existence of a "force" of gravitation apart from the fact; that Newton declared the ordinary notion of such force to be inconceivable; that various attempts have been made to account for the order of facts we call gravitation, without recourse to the notion of attractive force; that, if such a force exists, it is utterly incompetent to account for Kepler's laws, without taking into the reckoning a great number of other considerations; and, finally, that all we know about the "force" [115] of gravitation, or any other so-called "force," is that it is a name for the hypothetical cause of an observed order of facts.

Thus, when the Duke of Argyll says: "Force, ascertained according to some measure of its operation–this is indeed one of the definitions, but only one, of a scientific law" (p. 71) I reply that it is a definition which must be repudiated by every one who possesses an adequate acquaintance with either the facts, or the philosophy, of science, and be relegated to the limbo of pseudo-scientific fallacies. If the human mind had never entertained this notion of "force," nay, if it substituted bare invariable succession for the ordinary notion of causation, the idea of law, as the expression of a constantly-observed order, which generates a corresponding intensity of expectation in our minds, would have exactly the same value, and play its part in real science, exactly as it does now.

It is needless to extend further the present excursus on the origin and history of modern pseudo-science. Under such high patronage as it has enjoyed, it has grown and flourished until, nowadays, it is becoming somewhat rampant. It has its weekly "Ephemerides," in which every new pseudo-scientific mare's-nest is hailed and belauded with the unconscious unfairness of ignorance; and an army of "reconcilers," enlisted in its service, whose business seems to be to mix the black of dogma and the white of science into [116] the neutral tint of what they call liberal theology.

I remember that, not long after the publication of the "Vestiges," a shrewd and sarcastic countryman of the author defined it as "cauld kail made het again." A cynic might find amusement in the reflection that, at the present time, the principles and the methods of the much-vilified Vestigiarian are being "made het again"; and are not only "echoed by the dome of St. Paul's," but thundered from the castle of Inverary. But my turn of mind is not cynical, and I can but regret the waste of time and energy bestowed on the endeavour to deal with the most difficult problems of science, by those who have neither undergone the discipline, nor possess the information, which are indispensable to the successful issue of such an enterprise.

I have already had occasion to remark that the Duke of Argyll's views of the conduct of controversy are different from mine; and this much-to-be lamented discrepancy becomes yet more accentuated when the Duke reaches biological topics. Anything that was good enough for Sir Charles Lyell, in his department of study, is certainly good enough for me in mine; and I by no means demur to being pedagogically instructed about a variety of matters with which it has been the business of my life to try to acquaint myself. But the Duke of Argyll is not content with favouring me with his opinions about my own business; he also answers for mine; and, at that point, really the worm must turn. I am told that "no one knows better than Professor Huxley" a variety of things which I really do not know; and I am said to be a disciple of that "Positive Philosophy" which I have, over and over again, publicly repudiated in language which is certainly not lacking in intelligibility, whatever may be its other defects.

I am told that I have been amusing myself with a "metaphysical exercitation or logomachy" (may I remark incidentally that these are not quite convertible terms?), when, to the best of my belief, I have been trying to expose a process of mystification, based upon the use of scientific language by writers who exhibit no sign of scientific training, of accurate scientific knowledge, or of clear ideas respecting the philosophy of science, which is doing very serious harm to the public. Naturally enough, they take the lion's skin of scientific phraseology for evidence that the voice which issues from beneath it is the voice of science, and I desire to relieve them from the consequences of their error.

The Duke of Argyll asks, apparently with sorrow that it should be his duty to subject me to reproof–

"What shall we say of a philosophy which confounds the organic with the inorganic, and, refusing to take note of a difference so [118] profound, assumes to explain under one common abstraction, the movements due to gravitation and the movements due to the mind of man?"

To which I may fitly reply by another question: What shall we say to a controversialist who attributes to the subject of his attack opinions which are notoriously not his; and expresses himself in such a manner that it is obvious he is unacquainted with even the rudiments of that knowledge which is necessary to the discussion into which he has rushed?

What line of my writing can the Duke of Argyll produce which confounds the organic with the inorganic?

As to the latter half of the paragraph, I have to confess a doubt whether it has any definite meaning. But I imagine that the Duke is alluding to my assertion that the law of gravitation is nowise "suspended" or "defied" when a man lifts his arm; but that, under such circumstances, part of the store of energy in the universe operates on the arm at a mechanical advantage as against the operation of another part. I was simple enough to think that no one who had as much knowledge of physiology as is to be found in an elementary primer, or who had ever heard of the greatest physical generalisation of modern times–the doctrine of the conservation of energy–would dream of doubting my statement; and I was further simple enough to think that no one who [119] lacked these qualifications would feel tempted to charge me with error. It appears that my simplicity is greater than my powers of imagination.

The Duke of Argyll may not be aware of the fact, but it is nevertheless true, that when a man's arm is raised, in sequence to that state of consciousness we call a volition, the volition is not the immediate cause of the elevation of the arm. On the contrary, that operation is effected by a certain change of form, technically known as "contraction" in sundry masses of flesh, technically known as muscles, which are fixed to the bones of the shoulder in such a manner that, if these muscles contract, they must raise the arm. Now each of these muscles is a machine comparable, in a certain sense, to one of the donkey-engines of a steamship, but more complete, inasmuch as the source of its ability to change its form, or contract, lies within itself. Every time that, by contracting, the muscle does work, such as that involved in raising the arm, more or less of the material which it contains is used up, just as more or less of the fuel of a steam-engine is used up, when it does work. And I do not think there is a doubt in the mind of any competent physicist, or physiologist, that the work done in lifting the weight of the arm is the mechanical equivalent of a certain proportion of the energy set free by the molecular changes which take place in the muscle. It is further a tolerably well-based belief that this, and all other [120] forms of energy, are mutually convertible; and, therefore, that they all come under that general law or statement of the order of facts, called the conservation of energy. And, as that certainly is an abstraction, so the view which the Duke of Argyll thinks so extremely absurd is really one of the commonplaces of physiology. But this Review is hardly an appropriate place for giving instruction in the elements of that science, and I content myself with recommending the Duke of Argyll to devote some study to Book II. chap. v. section 4 of my friend Dr. Foster's excellent text-book of Physiology (1st edition, 1877, p. 321), which begins thus:–

"Broadly speaking, the animal body is a machine for converting potential into actual energy. The potential energy is supplied by the food; this the metabolism of the body converts into the actual energy of heat and mechanical labour."

There is no more difficult problem in the world than that of the relation of the state of consciousness, termed volition, to the mechanical work which frequently follows upon it. But no one can even comprehend the nature of the problem, who has not carefully studied the long series of modes of motion which, without a break, connect the energy which does that work with the general store of energy. The ultimate form of the problem is this: Have we any reason to believe that a feeling, or state of consciousness is capable [121] of directly affecting the motion of even the smallest conceivable molecule of matter? Is such a thing even conceivable? If we answer these questions in the negative, it follows that volition may be a sign, but cannot be a cause, of bodily motion. If we answer them in the affirmative, then states of consciousness become undistinguishable from material things; for it is the essential nature of matter to be the vehicle or substratum of mechanical energy.

There is nothing new in all this. I have merely put into modern language the issue raised by Descartes more than two centuries ago. The philosophies of the Occasionalists, of Spinoza, of Malebranche, of modern idealism and modern materialism, have all grown out of the controversies which Cartesianism evoked. Of all this the pseudo-science of the present time appears to be unconscious; otherwise it would hardly content itself with "making het again" the pseudo-science of the past.

In the course of these observations I have already had occasion to express my appreciation of the copious and perfervid eloquence which enriches the Duke of Argyll's pages. I am almost ashamed that a constitutional insensibility to the Sirenian charms of rhetoric has permitted me, in wandering through these flowery meads, to be attracted, almost exclusively, to the bare places of fallacy and the stony grounds of deficient [122] information, which are disguised, though not concealed, by these floral decorations. But, in his concluding sentences, the Duke soars into a Tyrtæan strain which roused even my dull soul.

"It was high time, indeed, that some revolt should be raised against that Reign of Terror which had come to be established in the scientific world under the abuse of a great name. Professor Huxley has not joined this revolt openly, for as yet, indeed, it is only beginning to raise its head. But more than once–and very lately–he has uttered a warning voice against the shallow dogmatism that has provoked it. The time is coming when that revolt will be carried further. Higher interpretations will be established. Unless I am much mistaken, they are already coming in sight" (p. 339).

I have been living very much out of the world for the last two or three years, and when I read this denunciatory outburst, as of one filled with the spirit of prophecy, I said to myself, "Mercy upon us, what has happened? Can it be that X. and Y. (it would be wrong to mention the names of the vigorous young friends which occurred to me) are playing Danton and Robespierre; and that a guillotine is erected in the courtyard of Burlington House for the benefit of all anti-Darwinian Fellows of the Royal Society? Where are the secret conspirators against this tyranny, whom I am supposed to favour, and yet not have the courage to join openly? And to think of my poor oppressed friend, Mr. Herbert Spencer, 'compelled to speak with bated breath' (p. 338) certainly for the first time in my thirty-odd years' [123] acquaintance with him!" My alarm and horror at the supposition that, while I had been fiddling (or at any rate physicking), my beloved Rome had been burning, in this fashion, may be imagined.

I am sure the Duke of Argyll will be glad to hear that the anxiety he created was of extremely short duration. It is my privilege to have access to the best sources of information, and nobody in the scientific world can tell me anything about either the "Reign of Terror" or "the Revolt." In fact, the scientific world laughs most indecorously at the notion of the existence of either; and some are so lost to the sense of the scientific dignity, that they descend to the use of transatlantic slang, and call it a "bogus scare." As to my friend Mr. Herbert Spencer, I have every reason to know that, in the "Factors of Organic Evolution," he has said exactly what was in his mind, without any particular deference to the opinions of the person whom he is pleased to regard as his most dangerous critic and Devil's Advocate-General, and still less of any one else.

I do not know whether the Duke of Argyll pictures himself as the Tallien of this imaginary revolt against a no less imaginary Reign of Terror. But if so, I most respectfully but firmly decline to join his forces. It is only a few weeks since I happened to read over again the first article which I ever wrote (now twenty-seven years ago) [124] on the "Origin of Species," and I found nothing that I wished to modify in the opinions that are there expressed, though the subsequent vast accumulation of evidence in favour of Mr. Darwin's views would give me much to add. As is the case with all new doctrines, so with that of Evolution, the enthusiasm of advocates has sometimes tended to degenerate into fanaticism; and mere speculation has, at times, threatened to shoot beyond its legitimate bounds. I have occasionally thought it wise to warn the more adventurous spirits among us against these dangers, in sufficiently plain language; and I have sometimes jestingly said that I expected, if I lived long enough, to be looked on as a reactionary by some of my more ardent friends. But nothing short of midsummer madness can account for the fiction that I am waiting till it is safe to join openly a revolt, hatched by some person or persons unknown, against an intellectual movement with which I am in the most entire and hearty sympathy. It is a great many years since, at the outset of my career, I had to think seriously what life had to offer that was worth having. I came to the conclusion that the chief good, for me, was freedom to learn, think, and say what I pleased, when I pleased. I have acted on that conviction, and have availed myself of the "rara temporum felicitas ubi sentire quæ velis, et quæ sentias dicere licet," which is now enjoyable, [125] to the best of my ability; and though strongly, and perhaps wisely, warned that I should probably come to grief, I am entirely satisfied with the results of the line of action I have adopted.

My career is at an end. I have

Warmed both hands before the fire of life;

and nothing is left me, before I depart, but to help, or at any rate to abstain from hindering, the younger generation of men of science in doing better service to the cause we have at heart than I have been able to render.

And yet, forsooth, I am supposed to be waiting for the signal of "revolt," which some fiery spirits among these young men are to raise before I dare express my real opinions concerning questions about which we older men had to fight, in the teeth of fierce public opposition and obloquy–of something which might almost justify even the grandiloquent epithet of a Reign of Terror–before our excellent successors

had left school.

It would appear that the spirit of pseudo-science has impregnated even the imagination of the Duke of Argyll. The scientific imagination always restrains itself within the limits of probability.

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[1] *Nineteenth Century*, March 1887.

[2] The Duke of Argyll speaks of the recent date of the demonstration of the fallacy of the doctrine in question. "Recent" is a relative term, but I may mention that the question is fully discussed in my book on *Hume*, which, if I may believe my publishers, has been read by a good many people since it appeared in l879. Moreover, I observe, from a note at page 89 of *The Reign of Law*, a work to which I shall have occasion to advert by and by, that the Duke of Argyll draws attention to the circumstance that, so long ago as 1866, the views which I hold on this subject were well known. The Duke, in fact, writing about this time, says, after quoting a phrase of mine: "The question of miracles seems now to be admitted on all hands to be simply a question of evidence." In science, we think that a teacher who ignores views which have been discussed *coram populo* for twenty years, is hardly up to the mark.

[3] See also vol. i. p. 460. In the ninth edition (1853), published twenty-three years after the first, Lyell deprives even the most careless reader of any excuse for misunderstanding him. So in regard to subterranean movements, the theory of the perpetual uniformity of the force which they exert on the earth-crust is quite consistent with the admission of their alternate development and suspension for indefinite periods within limited geographical areas" (p. 187).

[4] A great many years ago (Presidential Address to the Geological Society, 1869) I ventured to indicate that which seemed to me to be the weak point, not in the fundamental principles of uniformitarianism, but in uniformitarianism as taught by Lyell. It lay, to my mind, in the refusal by Hutton, and in a less degree by Lyell, to look beyond the limits of the time recorded by the stratified rocks. I said: "This attempt to limit, at a particular point, the progress of inductive and deductive reasoning from the things which are to the things which were–this faithlessness to its own logic, seems to me to have cost uniformitarianism the place as the permanent form of geological speculation which it might otherwise have held" (*Lay Sermons*, p. 260)). The context shows that "uniformitarianism" here means that doctrine, as limited in application by Hutton and Lyell, and that what I mean by "evolutionism" is consistent and thoroughgoing uniformitarianism.

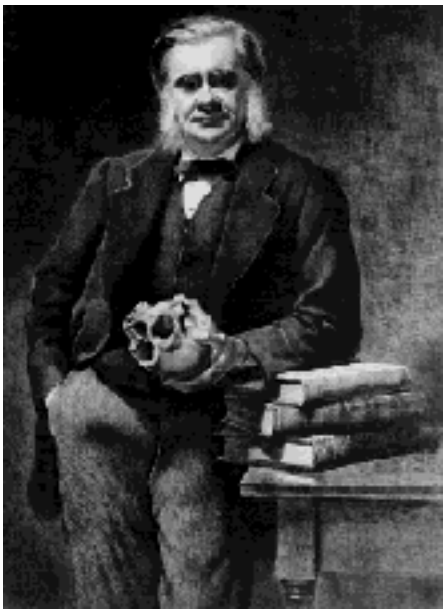
[5] *Philosophy of the Inductive Sciences*, vol. i, p. 670. New edition, 1847.

[6] At Glasgow in 1856.

[7] *Optics*, query 31.

[8] The author recognises this in his *Explanations.*

THE HUXLEY FILE



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C. Blinderman & D. Joyce
Clark University

An Episcopal Trilogy

The Nineteenth Century (November 1887)

Collected Essays V

[126] If there is any truth in the old adage that a burnt child dreads the fire, I ought to be very loath to touch a sermon, while the memory of what befell me on a recent occasion, possibly not yet forgotten by the readers of the *Nineteenth Century*, is uneffaced. But I suppose that even the distinguished censor of that unheard-of audacity to which not even the newspaper report of a sermon is sacred, can hardly regard a man of science as either indelicate or presumptuous, if he ventures to offer some comments upon three discourses, specially addressed to the great assemblage of men of science which recently gathered at Manchester, by three bishops of the State Church. On my return to England not long ago, I found a pamphlet[1] containing a version, which I presume [127] to be authorized, of these sermons, among the huge mass of letters and papers which had accumulated during two months' absence; and I have read them not only with attentive interest, but with a feeling of satisfaction which is quite new to me as a result of hearing, or reading, sermons. These excellent discourses, in fact, appear to me to signalize a new departure in the course adopted by theology towards science, and to indicate the possibility of bringing about an honourable *modus vivendi* between the two. How far the three bishops speak as accredited representatives of the Church is a question to be considered by and by. Most assuredly, I am not authorized to represent any one but myself. But I suppose that there must be a good many people in the Church of the bishops' way of thinking; and I have reason to believe that, in the ranks of science, there are a good many persons who, more or less, share my views. And it is to these sensible people on both sides, as the bishops and I must needs think those who agree with us, that my present observations are addressed. They will probably be astonished to learn how insignificant, in principle, their differences are.

It is impossible to read the discourses of the three prelates without being impressed by the [128] knowledge which they display, and by the spirit of equity, I might say of generosity, towards science which pervades them. There is no trace of that tacit or open assumption that the rejection of theological dogmas, on scientific grounds, is due to moral perversity, which is the ordinary note of ecclesiastical homilies on this subject, and which makes them look so supremely silly to men whose lives have been spent in wrestling with these questions. There is no attempt to hide away real stumbling-blocks under rhetorical stucco; no resort to the *tu quoque* device of setting scientific blunders against theological errors; no suggestion that an honest man may keep contradictory beliefs in separate pockets of his brain; no question that the method of scientific investigation is valid, whatever the results to which it may lead; and that the search after truth, and truth only, ennobles the searcher and leaves no doubt that his life, at any rate, is worth living. The Bishop of Carlisle declares himself pledged to the belief that "the advancement of science, the progress of human knowledge, is in itself a worthy aim of the greatest effort of the greatest minds."

How often was it my fate, a quarter of a century ago, to see the whole artillery of the pulpit brought to bear upon the doctrine of evolution and its supporters! Any one unaccustomed to the amenities of ecclesiastical controversy would have thought we were too wicked to be permitted to live. But [129] let us hear the Bishop of Bedford. After a perfectly frank statement of the doctrine of evolution and some of its obvious consequences, that learned prelate pleads, with all earnestness, against

"a hasty denunciation of what *may* be proved to have at least some elements of truth in it, a contemptuous rejection of theories which we *may* some day learn to accept as freely and with as little sense of inconsistency with God's word as we now accept the theory of the earth's motion round the sun, or the long duration of the geological epochs" (p. 28).

I do not see that the most convinced evolutionist could ask any one, whether cleric or layman, to say more than this; in fact, I do not think that any one has a right to say more, with respect to any question about which two opinions can be held, than that his mind is perfectly open to the force of evidence.

There is another portion of the Bishop of Bedford's sermon which I think will be warmly appreciated by all honest and clear-headed men. He repudiates the views of those who say that theology and science

"occupy wholly different spheres, and need in no way intermeddle with each other. They revolve, as it were, in different planes, and so never meet. Thus we may pursue scientific studies with the utmost freedom and, at the same time, may pay the most reverent regard to theology, having no fears of collision, because allowing no points of contact" (p. 29).

Surely every unsophisticated mind will heartily [130] concur with the Bishop's remark upon this convenient refuge for the descendants of Mr. Facing-both-ways. "I have never been able to understand this position, though I have often seen it assumed." Nor can any demurrer be sustained when the Bishop proceeds to point out that there are, and must be, various points of contact between theological and natural science, and therefore that it is foolish to ignore or deny the existence of as many dangers of collision.

Finally, the Bishop of Manchester freely admits the force of the objections which have been raised, on scientific grounds, to prayer, and attempts to turn them by arguing that the proper objects of prayer are not physical but spiritual. He tells us that natural accidents and moral misfortunes are not to be taken for moral judgments of God; he admits the propriety of the application of scientific methods to the investigation of the origin and growth of religions; and he is as ready to recognise the process of evolution there, as in the physical world. Mark the following striking passage:–

"And how utterly all the common objections to Divine revelation vanish away when they are set in the light of this theory of a spiritual progression. Are we reminded that there prevailed in those earlier days, views of the nature of God and man, of human life and Divine Providence, which we now find to be untenable? *That,* we answer, is precisely what the theory of development presupposes. If early views of religion and morality had not been imperfect, where had been the development? If symbolical visions and mythical creations had found no place [131] in the early Oriental expression of Divine truth, where had been the development? The sufficient

answer to ninety-nine out of a hundred of the ordinary objections to the Bible, as the record of a divine education of our race, is asked in that one word–development. And to what are we indebted for that potent word, which, as with the wand of a magician, has at the same moment so completely transformed our knowledge and dispelled our difficulties? To modern science, resolutely pursuing its search for truth in spite of popular obloquy and–alas! that one should have to say it–in spite too often of theological denunciation" (p. 53).

Apart from its general importance, I read this remarkable statement with the more pleasure, since, however imperfectly I may have endeavoured to illustrate the evolution of theology in a paper published in the *Nineteenth Century* last year,[2] it seems to me that in principle, at any rate, I may hereafter claim high theological sanction for the views there set forth.

If theologians are henceforward prepared to recognise the authority of secular science in the manner and to the extent indicated in the Manchester trilogy; if the distinguished prelates who offer these terms are really plenipotentiaries, then, so far as I may presume to speak on such a matter, there will be no difficulty about concluding a perpetual treaty of peace, and indeed of alliance, between the high contracting powers, whose history has hitherto been little more than a record of continual warfare. But if the great Chancellor's [132] maxim, "Do ut des," is to form the basis of negotiation, I am afraid that secular science will be ruined; for it seems to me that theology, under the generous impulse of a sudden conversion, has given all that she hath; and indeed, on one point, has surrendered more than can reasonably be asked.

I suppose I must be prepared to face the reproach which attaches to those who criticise a gift, if I venture to observe that I do not think that the Bishop of Manchester need have been so much alarmed, as he evidently has been, by the objections which have often been raised to prayer, on the ground that a belief in the efficacy of prayer is inconsistent with a belief in the constancy of the order of nature.

The Bishop appears to admit that there is an antagonism between the "regular economy of nature" and the "regular economy of prayer" (p. 39), and that "prayers for the interruption of God's natural order" are of "doubtful validity" (p. 42). It appears to me that the Bishop's difficulty simply adds another example to those which I have several times insisted upon in the pages of this Review and elsewhere, of the mischief which has been done, and is being done, by a mistaken apprehension of the real meaning of "natural order" and "law of nature."

May I, therefore, be permitted to repeat, once more, that the statements denoted by these terms have no greater value or cogency than such as may [133] attach to generalizations from experience of the past, and to expectations for the future based upon that experience? Nobody can presume to say what the order of nature must be; all that the widest experience (even if it extended over all past time and through all space) that events had happened in a certain way could justify, would be a proportionally strong expectation that events will go on so happening, and the demand for a proportional strength of evidence in favour of any assertion that they had happened otherwise.

It is this weighty consideration, the truth of which every one who is capable of logical thought must

surely admit, which knocks the bottom out of all *a priori* objections either to ordinary "miracles" or to the efficacy of prayer, in so far as the latter implies the miraculous intervention of a higher power. No one is entitled to say *a priori* that any given so-called miraculous event is impossible; and no one is entitled to say *a priori* that prayer for some change in the ordinary course of nature cannot possibly avail.

The supposition that there is any inconsistency between the acceptance of the constancy of natural order and a belief in the efficacy of prayer, is the more unaccountable as it is obviously contradicted by analogies furnished by everyday experience. The belief in the efficacy of prayer depends upon the assumption that there is somebody, somewhere, who is strong enough to deal with the earth and its contents as men deal with the things and events [134] which they are strong enough to modify or control; and who is capable of being moved by appeals such as men make to one another. This belief does not even involve theism; for our earth is an insignificant particle of the solar system, while the solar system is hardly worth speaking of in relation to the All; and, for anything that can be proved to the contrary, there may be beings endowed with full powers over our system, yet, practically, as insignificant as ourselves in relation to the universe. If any one pleases, therefore, to give unrestrained liberty to his fancy, he may plead analogy in favour of the dream that there may be, somewhere, a finite being, or beings, who can play with the solar system as a child plays with a toy; and that such being may be willing to do anything which he is properly supplicated to do. For we are not justified in saying that it is impossible for beings having the nature of men, only vastly more powerful, to exist; and if they do exist, they may act as and when we ask them to do so, just as our brother men act. As a matter of fact, the great mass of the human race has believed, and still believes, in such beings, under the various names of fairies, gnomes, angels, and demons. Certainly I do not lack faith in the constancy of natural order. But I am not less convinced that if I were to ask the Bishop of Manchester to do me a kindness which lay within his power, he would do it. And I am unable to see that his action on my request involves any violation of the order of [135] nature. On the contrary, as I have not the honour to know the Bishop personally, my action would be based upon my faith in that "law of nature," or generalization from experience, which tells me that, as a rule, men who occupy the Bishop's position are kindly and courteous. How is the case altered if my request is preferred to some imaginary superior being, or to the Most High being, who, by the supposition, is able to arrest disease, or make the sun stand still in the heavens, just as easily as I can stop my watch, or make it indicate any hour that pleases me?

I repeat that it is not upon any *a priori* considerations that objections, either to the supposed efficacy of prayer in modifying the course of events, or to the supposed occurrence of miracles, can be scientifically based. The real objection, and, to my mind, the fatal objection, to both these suppositions, is the inadequacy of the evidence to prove any given case of such occurrences which has been adduced. It is a canon of common sense, to say nothing of science, that the more improbable a supposed occurrence, the more cogent ought to be the evidence in its favour. I have looked somewhat carefully into the subject, and I am unable to find in the records of any miraculous event evidence which even approximates to the fulfilment of this requirement.

But, in the case of prayer, the Bishop points out a most just and necessary distinction between its [136] effect on the course of nature, outside ourselves, and its effect within the region of the supplicatory mind.

It is a "law of nature," verifiable by everyday experience, that our already formed convictions, our strong desires, our intent occupation with particular ideas, modify our mental operations to a most marvellous extent, and produce enduring changes in the direction and in the intensity of our intellectual and moral activities. Men can intoxicate themselves with ideas as effectually as with alcohol or with bang, and produce, by dint of intense thinking, mental conditions hardly distinguishable from monomania. Demoniac possession is mythical; but the faculty of being possessed, more or less completely, by an idea is probably the fundamental condition of what is called genius, whether it show itself in the saint, the artist, or the man of science. One calls it faith, another calls it inspiration, a third calls it insight; but the "intending of the mind," to borrow Newton's well-known phrase, the concentration of all the rays of intellectual energy on some one point, until it glows and colours the whole cast of thought with its peculiar light, is common to all.

I take it that the Bishop of Manchester has psychological science with him when he insists upon the subjective efficacy of prayer in faith, and on the seemingly miraculous effects which such [137] "intending of the mind" upon religious and moral ideals may have upon character and happiness. Scientific faith, at present, takes it no further than the prayer which Ajax offered; but that petition is continually granted.

Whatever points of detail may yet remain open for discussion, however, I repeat the opinion I have already expressed, that the Manchester sermons concede all that science has an indisputable right, or any pressing need, to ask, and that not grudgingly but generously; and, if the three bishops of 1887 carry the Church with them, I think they will have as good title to the permanent gratitude of posterity as the famous seven who went to the Tower in defence of the Church two hundred years ago.

Will their brethren follow their just and prudent guidance? I have no such acquaintance with the currents of ecclesiastical opinion as would justify me in even hazarding a guess on such a difficult topic. But some recent omens are hardly favourable. There seems to be an impression abroad–I do not desire to give any countenance to it–that I am fond of reading sermons. From time to time, unknown correspondents–some apparently animated by the charitable desire to promote my conversion, and others unmistakably anxious to spur me to the expression of wrathful antagonism–favour me with reports or copies of such productions.

[138] I found one of the latter category among the accumulated arrears to which I have already referred.

It is a full, and apparently accurate, report of a discourse by a person of no less ecclesiastical rank than the three authors of the sermons I have hitherto been considering; but who he is, and where or when the sermon was preached, are secrets which wild horses shall not tear from me, lest I fall again under high censure for attacking a clergyman. Only if the editor of this Review thinks it his duty to have independent evidence that the sermon has a real existence, will I, in the strictest confidence, communicate it to him.

The preacher, in this case, is of a very different mind from the three bishops–and this mind is different in

quality, different in spirit, and different in contents. He discourses on the *a priori* objections to miracles, apparently without being aware, in spite of all the discussions of the last seven or eight years, that he is doing battle with a shadow.

I trust I do not misrepresent the Bishop of Manchester in saying that the essence of his remarkable discourse is the insistence upon the "supreme importance of the purely spiritual in our faith," and of the relative, if not absolute, insignificance of aught else. He obviously perceives the bearing of his arguments against the [139] alterability of the course of outward nature by prayer, on the question of miracles in general; for he is careful to say that "the possibility of miracles, of a rare and unusual transcendence of the world order is not here in question" (p. 38). It may be permitted me to suppose, however, that, if miracles were in question, the speaker who warns us "that we must look for the heart of the absolute religion in that part of it which prescribes our moral and religious relations" (p. 46) would not be disposed to advise those who had found the heart of Christianity to take much thought about its miraculous integument.

My anonymous sermon will have nothing to do with such notions as these, and its preacher is not too polite, to say nothing of charitable, towards those who entertain them.

"Scientific men, therefore, are perfectly right in asserting that Christianity rests on miracles. If miracles never happened, Christianity, in any sense which is not a mockery, which does not make the term of none effect, has no reality. I dwell on this because there is now an effort making to get up a non-miraculous, invertebrate Christianity, which may escape the ban of science. And I would warn you very distinctly against this new contrivance. Christianity is essentially miraculous, and falls to the ground if miracles be impossible."

Well, warning for warning. I venture to warn this preacher and those who, with him, persist in identifying Christianity with the miraculous, that such forms of Christianity are not only doomed to fall to the ground; but that, within the last [140] half century, they have been driving that way with continually accelerated velocity.

The so-called religious world is given to a strange delusion. It fondly imagines that it possesses the monopoly of serious and constant reflection upon the terrible problems of existence; and that those who cannot accept its shibboleths are either mere Gallios, caring for none of these things, or libertines desiring to escape from the restraints of morality. It does not appear to have entered the imaginations of these people that, outside their pale and firmly resolved never to enter it, there are thousands of men, certainly not their inferiors in character, capacity, or knowledge of the questions at issue, who estimate those purely spiritual elements of the Christian faith of which the Bishop of Manchester speaks as highly as the Bishop does; but who will have nothing to do with the Christian Churches, because in their apprehension and for them, the profession of belief in the miraculous, on the evidence offered, would be simply immoral.

So far as my experience goes, men of science are neither better nor worse than the rest of the world. Occupation with the endlessly great parts of the universe does not necessarily involve greatness of character, nor does microscopic study of the infinitely little always produce humility. We have our full

share of original sin; need, greed, and vainglory beset us as they do other [141] mortals; and our progress is, for the most part, like that of a tacking ship, the resultant of opposite divergencies from the straight path. But, for all that, there is one moral benefit which the pursuit of science unquestionably bestows. It keeps the estimate of the value of evidence up to the proper mark; and we are constantly receiving lessons, and sometimes very sharp ones, on the nature of proof. Men of science will always act up to their standard of veracity, when mankind in general leave off sinning; but that standard appears to me to be higher among them than in any other class of the community.

I do not know any body of scientific men who could be got to listen without the strongest expressions of disgusted repudiation to the exposition of a pretended scientific discovery, which had no better evidence to show for itself than the story of the devils entering a herd of swine, or of the fig-tree that was blasted for bearing no figs when "it was not the season of figs." Whether such events are possible or impossible, no man can say; but scientific ethics can and does declare that the profession of belief in them, on the evidence of documents of unknown date and of unknown authorship, is immoral. Theological apologists who insist that morality will vanish if their dogmas are exploded, would do well to consider the fact that, in the matter of intellectual veracity, science is already a long way ahead of the [142] Churches; and that, in this particular, it is exerting an educational influence on mankind of which the Churches have shown themselves utterly incapable.

Undoubtedly that varying compound of some of the best and some of the worst elements of Paganism and Judaism, moulded in practice by the innate character of certain people of the Western world, which, since the second century, has assumed to itself the title of orthodox Christianity, "rests on miracles" and falls to the ground, not "if miracles be impossible," but if those to which it is committed prove themselves unable to fulfil the conditions of honest belief. That this Christianity is doomed to fall is, to my mind, beyond a doubt; but its fall will be neither sudden nor speedy. The Church, with all the aid lent it by the secular arm, took many centuries to extirpate the open practice of pagan idolatry within its own fold; and those who have travelled in southern Europe will be aware that it has not extirpated the essence of such idolatry even yet. *Mutato nomine*, it is probable that there is as much sheer fetishism among the Roman populace now as there was eighteen hundred years ago; and if Marcus Antoninus could descend from his horse and ascend the steps of the Ara Cœli church about Twelfth Day, the only thing that need strike him would be the extremely contemptible character of the modern idols as works of art.

[143] Science will certainly neither ask for, nor receive, the aid of the secular arm. It will trust to the much better and more powerful help of that education in scientific truth and in the morals of assent, which is rendered as indispensable, as it is inevitable, by the permeation of practical life with the products and ideas of science. But no one who considers the present state of even the most developed countries can doubt that the scientific light that has come into the world will have to shine in the midst of darkness for a long time. The urban populations, driven into contact with science by trade and manufacture, will more and more receive it, while the *pagani* will lag behind. Let us hope that no Julian may arise among them to head a forlorn hope against the inevitable. Whatever happens, science may bide her time in patience and in confidence.

But to return to my "Anonymous." I am afraid that if he represents any great party in the Church, the

spirit of justice and reasonableness which animates the three bishops has as slender a chance of being imitated, on a large scale, as their common sense and their courtesy. For, not contented with misrepresenting science on its speculative side, "Anonymous" attacks its morality.

"For two whole years, investigations and conclusions which would upset the theories of Darwin on the formation of coral islands were actually suppressed, and that by the advice even of those who accepted them, *for fear of upsetting the faith and dis*[144]*turbing the judgment formed by the multitude on the scientific character–the infallibility–of the great master!*"

So far as I know anything about the matters which are here referred to, the part of this passage which I have italicised is absolutely untrue. I believe that I am intimately acquainted with all Mr. Darwin's immediate scientific friends: and I say that no one of them, nor any other man of science known to me, ever could, or would, have given such advice to any one–if for no other reason than that, with the example of the most candid and patient listener to objections that ever lived fresh in their memories, they could not so grossly have at once violated their highest duty and dishonoured their friend.

The charge thus brought by "Anonymous" affects the honour and the probity of men of science; if it is true, we have forfeited all claim to the confidence of the general public. In my belief it is utterly false, and its real effect will be to discredit those who are responsible for it. As is the way with slanders, it has grown by repetition.

"Anonymous" is responsible for the peculiarly offensive form which it has taken in his hands; but he is not responsible for originating it. He has evidently been inspired by an article entitled "**A Great Lesson**," published in the September number of this Review. Truly it is "a great lesson," but not quite in the sense intended by the giver thereof.

[145] In the course of his doubtless well-meant admonitions, the Duke of Argyll commits himself to a greater number of statements which are demonstrably incorrect and which any one who ventured to write upon the subject ought to have known to be incorrect, than I have ever seen gathered together in so small a space.

I submit a gathering from the rich store for the appreciation of the public.

First:–

"Mr Murray's new explanation of the structure of coral-reefs and islands was communicated to the Royal Society of Edinburgh in 1880, and supported with such a weight of facts and such a close texture of reasoning, that no serious reply has ever been attempted" (p. 305).

"No serious reply has ever been attempted"! I suppose that the Duke of Argyll may have heard of Professor Dana, whose years of labour devoted to corals and coral-reefs when he was naturalist of the American expedition under Commodore Wilkes, more than forty years ago, have ever since caused him

to be recognised as an authority of the first rank on such subjects. Now does his Grace know, or does he not know, that, in the year 1885, Professor Dana published an elaborate paper "On the Origin of Coral-Reefs and Islands," in which, after referring to a Presidential Address by the Director of the Geological Survey of Great Britain and Ireland delivered in 1883, in which special [146] attention is directed to Mr. Murray's views Professor Dana says:–

"The existing state of doubt on the question has led the writer to reconsider the earlier and later facts, and in the following pages he gives his results."

Professor Dana then devotes many pages of his very "serious reply" to a most admirable and weighty criticism of the objections which have at various times been raised to Mr. Darwin's doctrine by Professor Semper, by Dr. Rein, and finally by Mr. Murray, and he states his final judgment as follows:–

"With the theory of abrasion and solution incompetent, all the hypotheses of objectors to Darwin's theory are alike weak; for all have made these processes their chief reliance, whether appealing to a calcareous, or a volcanic, or a mountain-peak basement for the structure. The subsidence which the Darwinian theory requires has not been opposed by the mention of any fact at variance with it, nor by setting aside Darwin's arguments in its favour; and it has found new support in the facts from the "Challenger's" soundings off Tahiti, that had been put in array against it, and strong corroboration in the facts from the West Indies.

Darwin's theory, therefore, remains as the theory that accounts for the origin of reefs and islands."[3]

Be it understood that I express no opinion on the controverted points. I doubt if there are ten living men who, having a practical knowledge of what a coral-reef is, have endeavoured to master the very difficult biological and geological problems involved in their study. I happen to have [147] spent the best part of three years among coral-reefs and to have made that attempt; and, when Mr. Murray's work appeared, I said to myself that until I had two or three months to give to the renewed study of the subject in all its bearings, I must be content to remain in a condition of suspended judgment. In the meanwhile, the man who would be voted by common acclamation as the most competent person now living to act as umpire, has delivered the verdict I have quoted; and, to go no further, has fully justified the hesitation I and others may have felt about expressing an opinion. Under these circumstances, it seems to me to require a good deal of courage to say "no serious reply has ever been attempted"; and to chide the men of science, in lofty tones, for their "reluctance to admit an error" which is not admitted; and for their "slow and sulky acquiescence" in a conclusion which they have the gravest warranty for suspecting.

Second:–

"Darwin himself had lived to hear of the new solution, and, with that splendid candour which was eminent in him, his mind, though now grown old in his own early convictions, was at least ready to entertain it, and to confess that serious doubts had been awakened as to the truth of his famous theory" (p. 305).

I wish that Darwin's splendid candour could be conveyed by some description of spiritual "microbe" to those who write about him. I am not aware that Mr. Darwin ever entertained [148] "serious doubts as to

the truth of his famous theory"; and there is tolerably good evidence to the contrary. The second edition of his work, published in 1876, proves that he entertained no such doubts then; a letter to Professor Semper, whose objections, in some respects, forestalled those of Mr. Murray, dated October 2, 1879, expresses his continued adherence to the opinion "that the atolls and barrier reefs in the middle of the Pacific and Indian Oceans indicate subsidence"; and the letter of my friend Professor Judd, printed at the end of this article (which I had perhaps better say Professor Judd had not seen) will prove that this opinion remained unaltered to the end of his life.

Third:–

". . . Darwin's theory is a dream. It is not only unsound but it is in many respects the reverse of truth. With all his conscientiousness, with all his caution, with all his powers of observation, Darwin in this matter fell into errors as profound as the abysses of the Pacific" (p. 301).

[149] Really? It seems to me that, under the circumstances, it is pretty clear that these lines exhibit a lack of the qualities justly ascribed to Mr. Darwin, which plunges their author into a much deeper abyss, and one from which there is no hope of emergence.

Fourth:–

"All the acclamations with which it was received were as the shouts of an ignorant mob" (p. 301).

But surely it should be added that the Coryphæus of this ignorant mob, the fugleman of the shouts, was one of the most accomplished naturalists and geologists now living–the American Dana–who, after years of independent study extending over numerous reefs in the Pacific, gave his hearty assent to Darwin's views, and after all that had been said, deliberately reaffirmed that assent in the year 1888.

Fifth:–

"The overthrow of Darwin's speculation is only beginning to be known. It has been whispered for some time. The cherished dogma has been dropping very slowly out of sight" (p. 301).

Darwin's speculation may be right or wrong, but I submit that that which has not happened cannot even begin to be known, except by those who have miraculous gifts to which we poor scientific people do not aspire. The overthrow of Darwin's views may have been whispered by those who hoped for it; and they were perhaps wise in not raising their voices above a whisper. Incorrect statements, if made too loudly, are apt to bring about unpleasant consequences.

Sixth:–

Mr. Murray's views, published in 1880, are said to have met with "slow and sulky acquiescence" (p. 305). I have proved that they cannot be said to have met with general acquiescence of any sort, whether

quick and cheerful, or slow and sulky; and if this assertion is meant [150] to convey the impression that Mr. Murray's views have been ignored, that there has been a conspiracy of silence against them, it is utterly contrary to notorious fact.

Professor Geikie's well-known "Textbook of Geology" was published in 1882, and at pages 457-59 of that work there is a careful exposition of Mr. Murray's views. Moreover Professor Geikie has specially advocated them on other occasions,[4] notably in a long article on "The Origin of Coral-Reefs," published in two numbers of "Nature" for 1883, and in a Presidential Address delivered in the same year. If, in so short a time after the publication of his views, Mr Murray could boast of a convert, so distinguished and influential as the Director of the Geological Survey, it seems to me that this wonderful *conspiration de silence* (which has about as much real existence as the Duke of Argyll's other bogie, "The Reign of Terror") must have *ipso facto* collapsed. I wish that, when I was a young man, my endeavours to upset some prevalent errors had met with as speedy and effectual backing.

Seventh:–

". . . Mr. John Murray was strongly advised against the publication of his views in derogation of Darwin's long-accepted theory of the coral islands, and was actually induced to delay it for two years. Yet the late Sir Wyville Thomson, who was at the head of the naturalists of the "Challenger" expedition, was himself convinced by Mr. Murray's reasoning" (p. 307).

Clearly, then, it could not be Mr. Murray's official chief who gave him this advice. Who was it? And what was the exact nature of the advice given? Until we have some precise information on this head, I shall take leave to doubt whether this statement is more accurate than those which I have previously cited.

Whether such advice was wise or foolish, just or immoral, depends entirely on the motive of the person who gave it. If he meant to suggest to Mr. Murray that it might be wise for a young and comparatively unknown man to walk warily, when he proposed to attack a generalization based on many years' labour of one undoubtedly competent person, and fortified by the independent results of the many years' labour of another undoubtedly competent person; and even, if necessary, to take two whole years in fortifying his position, I think that such advice would have been sagacious and kind. I suppose that there are few working men of science who have not kept their ideas to themselves, while gathering and sifting evidence, for a much longer period than two years.

If, on the other hand, Mr. Murray was advised to delay the publication of his criticisms, simply to [152] save Mr. Darwin's credit and to preserve some reputation for infallibility, which no one ever heard of, then I have no hesitation in declaring that his adviser was profoundly dishonest, as well as extremely foolish; and that, if he is a man of science, he has disgraced his calling.

But, after all, this supposed scientific Achitophel has not yet made good the primary fact of his existence. Until the needful proof is forthcoming, I think I am justified in suspending my judgment as to

whether he is much more than an anti-scientific myth. I leave it to the Duke of Argyll to judge of the extent of the obligation under which, for his own sake, he may lie to produce the evidence on which his aspersions of the honour of scientific men are based. I cannot pretend that we are seriously disturbed by charges which every one who is acquainted with the truth of the matter knows to be ridiculous; but mud has a habit of staining if it lies too long, and it is as well to have it brushed off as soon as may be.

So much for the "Great Lesson." It is followed by a "Little Lesson," apparently directed against my infallibility–a doctrine about which I should be inclined to paraphrase Wilkes's remark to George the Third, when he declared that he, at any rate, was not a Wilkite. But I really should be glad to think that there are people who need the warning, because then it will be obvious that this raking up of an old story cannot have been [153] suggested by a mere fanatical desire to damage men of science. I can but rejoice, then, that these misguided enthusiasts, whose faith in me has so far exceeded the bounds of reason, should be set right. But that "want of finish" in the matter of accuracy which so terribly mars the effect of the "Great Lesson," is no less conspicuous in the case of the "Little Lesson," and, instead of setting my too fervent disciples right, it will set them wrong.

The Duke of Argyll, in telling the story of *Bathybius*, says that my mind was "caught by this new and grand generalization of the physical basis of life." I never have been guilty of a reclamation about anything to my credit, and I do not mean to be; but if there is any blame going, I do not choose to be relegated to a subordinate place when I have a claim to the first. The responsibility for the first description and the naming of *Bathybius* is mine and mine only. The paper on "Some Organisms living at great Depths in the Atlantic Ocean," in which I drew attention to this substance, is to be found by the curious in the eighth volume of the "Quarterly Journal of Microscopical Science," and was published in the year 1868. Whatever errors are contained in that paper are my own peculiar property; but neither at the meeting of the British Association in 1868, nor anywhere else, have I gone beyond what is there stated; except in so far that, at a long-sub[154]sequent meeting of the Association, being importuned about the subject, I ventured to express somewhat emphatically, the wish that the thing was at the bottom of the sea.

What is meant by my being caught by a generalization about the physical basis of life I do not know; still less can I understand the assertion that *Bathybius* was accepted because of its supposed harmony with Darwin's speculations. That which interested me in the matter was the apparent analogy of *Bathybius* with other well-known forms of lower life, such as the plasmodia of the Myxomycetes and the Rhizopods. Speculative hopes or fears had nothing to do with the matter; and if *Bathybius* were brought up alive from the bottom of the Atlantic to-morrow the fact would not have the slightest bearing, that I can discern, upon Mr. Darwin's speculations, or upon any of the disputed problems of biology. It would merely be one elementary organism the more added to the thousands already known.

Up to this moment I was not aware of the universal favour with which *Bathybius* was received.[5] Those simulators of an "ignorant mob" who, according to the Duke of Argyll, welcomed [155] coral-reefs, made no demonstration in my favour, unless his Grace includes Sir Wyville Thomson, Dr. Carpenter, Dr. Bessels, and Professor Haeckel under that head. On the contrary, a sagacious friend of mine, than

whom there was no more competent judge, the late Mr. George Busk, was not to be converted; while, long before the "Challenger" work, Ehrenberg wrote to me very skeptically; and I fully expected that that eminent man would favour me with pretty sharp criticism. Unfortunately, he died shortly afterwards, and nothing from him, that I know of, appeared. When Sir Wyville Thomson wrote to me a brief account of the results obtained on board the "Challenger" I sent this statement to "Nature," in which journal it appeared the following week, without any further note or comment than was needful to explain the circumstances. In thus allowing judgment to go by default, I am afraid I showed a reckless and ungracious disregard for the feelings of the believers in my infallibility. No doubt I ought to have hedged and fenced and attenuated the effect of Sir Wyville Thomson's brief note in every possible way. Or perhaps I ought to have suppressed the note altogether, on the ground that it was a mere *ex parte* statement. My excuse is that, notwithstanding a large and abiding faith in human folly, I did not know then, any more than I know now, that there was anybody foolish enough to be unaware that [156] the only people scientific or other, who never make mistakes are those who do nothing; or that anybody, for whose opinion I cared, would not rather see me commit ten blunders than try to hide one.

Pending the production of further evidence, I hold that the existence of people who believe in the infallibility of men of science is as purely mythical as that of the evil counsellor who advised the withholding of the truth lest it should conflict with that belief.

I venture to think, then, that the Duke of Argyll might have spared his "Little Lesson" as well as his "Great Lesson" with advantage. The paternal authority who whips the child for sins he has not committed does not strengthen his moral influence–rather excites contempt and repugnance. And if, as would seem from this and former monitory allocations which have been addressed to us, the Duke aspires to the position of censor, or spiritual director, in relation to the men who are doing the work of physical science, he really must get up his facts better. There will be an end to all chance of our kissing the rod if his Grace goes wrong a third time. He must not say again that "no serious reply has been attempted" to a view which was discussed and repudiated, two years before, by one of the highest extant authorities on the subject; he must not say that Darwin accepted that which it can be proved he did not accept; he must not say that a doctrine [157] has dropped into the abyss when it is quite obviously alive and kicking at the surface; he must not assimilate a man like Professor Dana to the components of an "ignorant mob"; he must not say that things are beginning to be known which are not known at all; he must not say that "slow and sulky acquiescence" has been given to that which cannot yet boast of general acquiescence of any kind; he must not suggest that a view which has been publicly advocated by the Director of the Geological Survey and no less publicly discussed by many other authoritative writers has been intentionally and systematically ignored; he must not ascribe ill motives for a course of action which is the only proper one; and finally, if any one but myself were interested, I should say that he had better not waste his time in raking up the errors of those whose lives have been occupied, not in talking about science, but in toiling, sometimes with success and sometimes with failure, to get some real work done.

The most considerable difference I note among men is not in their readiness to fall into error, but in their readiness to acknowledge these inevitable lapses. The Duke of Argyll has now a splendid opportunity for proving to the world in which of these categories it is hereafter to rank him.

Dear Professor Huxley,–A short time before Mr. Darwin's death, I had a conversation [158] with him concerning the observations which had been made by Mr. Murray upon coral-reefs, and the speculations which had been founded upon those observations. I found that Mr. Darwin had very carefully considered the whole subject, and that while, on the one hand, he did not regard the actual facts recorded by Mr. Murray as absolutely inconsistent with his own theory of subsidence, on the other hand, he did not believe that they necessitated or supported the hypothesis advanced by Mr. Murray. Mr. Darwin's attitude, as I understood it, towards Mr. Murray's objections to the theory of subsidence was exactly similar to that maintained by him with respect to Professor Semper's criticism, which was of a very similar character; and his position with regard to the whole question was almost identical with that subsequently so clearly defined by Professor Dana in his well-known articles published in the "American Journal of Science" for 1885.

It is difficult to imagine how any one, acquainted with the scientific literature of the last seven years, could possibly suggest that Mr Murray's memoir published in 1880 had failed to secure a due amount of attention. Mr. Murray, by his position in the "Challenger" office, occupied an exceptionally favourable position for making his views widely known; and he had, moreover, the singular good fortune to secure from the first the advocacy of so able and brilliant a writer as [159] Professor Archibald Geikie, who in a special discourse and in several treatises on geology and physical geology very strongly supported the new theory. It would be an endless task to attempt to give references to the various scientific journals which have discussed the subject, but I may add that every treatise on geology which has been published, since Mr. Murray's views were made known, has dealt with his observations at considerable length. This is true of Professor A. H. Green's "Physical Geology," published in 1882; of Professor Prestwich's "Geology, Chemical and Physical"; and of Professor James Geikie's "Outlines of Geology," published in 1886. Similar prominence is given to the subject in De Lapparent's "Traité de Géologie," published in 1885, and in Credner's "Elemente der Geologie," which has appeared during the present year. If this be a "conspiracy of silence," where, alas! can the geological speculator seek for fame?–Yours very truly,

John W. Judd.
October 10, 1887.

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[1] *The Advance of Science.* Three sermons preached in Manchester Cathedral on Sunday, September 4, 1887, during the meeting of the British Association for the Advancement of Science, by the Bishop of Carlisle, the Bishop of Bedford, and the Bishop of Manchester.

[2] Reprinted in Vol. IV. of this collection.

[3] *American Journal of Science*, 1885, p. 190.

[4] Professor Geikie, however, though a strong, is a fair and candid advocate. He says of Darwin's theory, "That it may be possibly true, in some instances may be readily granted." For Professor Geikie, then, it is not yet overthrown–still less a dream.

[5] I find, moreover, that I specially warned my readers against hasty judgment. After stating the facts of observation, I add, "I have, hitherto, said nothing about their meaning, as, in an inquiry so difficult and fraught with interest as this, it seems to me to be in the highest degree important to keep the questions of fact and the questions of interpretation well apart" (p. 210).

THE HUXLEY FILE

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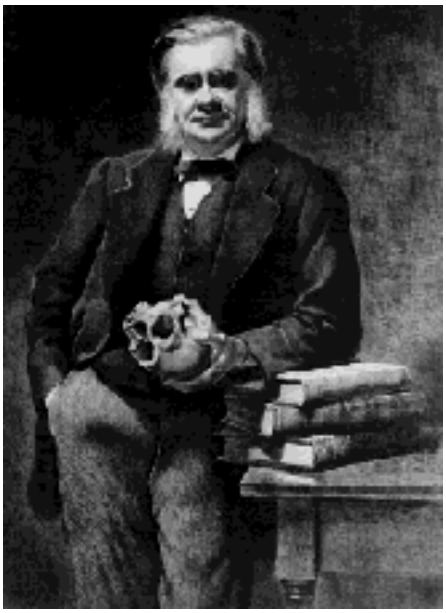

The Value of Witness to the Miraculous

The Nineteenth Century (March 1887)

Collected Essays V

[160] Charles, or, more properly, Karl, King of the Franks, consecrated Roman Emperor in St. Peter's on Christmas Day, A.D. 800, and known to posterity as the Great (chiefly by his agglutinative Gallicised denomination of Charlemagne), was a man great in all ways, physically and mentally. Within a couple of centuries after his death Charlemagne became the centre of innumerable legends; and the myth-making process does not seem to have been sensibly interfered with by the existence of sober and truthful histories of the Emperor and of the times which immediately preceded and followed his reign, by a contemporary writer who occupied a high and confidential position in his court, and in that of his successor. This was one Eginhard, or Einhard, [161] who appears to have been born about A.D. 770, and spent his youth at the court, being educated along with Charles's sons. There is excellent contemporary testimony not only to Eginhard's existence, but to his abilities, and to the place which he occupied in the circle of the intimate friends of the great ruler whose life he subsequently wrote. In fact, there is as good evidence of Eginhard's existence, of his official position, and of his being the author of the chief works attributed to him, as can reasonably be expected in the case of a man who lived more than a thousand years ago, and was neither a great king nor a great warrior. The works are–1. "The Life of the Emperor Karl." 2. "The Annals of the Franks." 3. "Letters." 4. "The History of the Translation of the Blessed Martyrs of Christ, SS. Marcellinus and Petrus."

It is to the last, as one of the most singular and interesting records of the period during which the Roman world passed into that of the Middle Ages, that I wish to direct attention.[1] It was written in the ninth century, somewhere, apparently, about the year 830, when Eginhard, ailing in health and weary of political life, had withdrawn to the monastery of Seligenstadt, of which he was the founder. A manuscript copy of the work, made in the tenth century, and once the [162] property of the monastery of St. Bavon on the Scheldt, of which Eginhard was Abbot, is still extant, and there is no reason to believe that, in this copy, the original has been in any way interpolated or otherwise tampered with. The main features of the strange story contained in the "Historia Translationis" are set forth in the following pages, in which, in regard to all matters of importance, I shall adhere as closely as possible to Eginhard's own words.

"While I was still at Court, busied with secular affairs, I often thought of the leisure which I hoped one day to enjoy in a solitary place, far away from the crowd, with which the liberality of Prince Louis, whom I then served, had provided me. This place is situated in that part of Germany which lies between the Neckar and the Maine,[2] and is nowadays called the Odenwald by those who live in and about it. And here having built, according to my capacity and resources, not only houses and permanent dwellings, but also a basilica fitted for the performance of divine service and of no mean style of construction, I began to think to what saint or martyr I could best dedicate it. A good deal of time had passed while my thoughts fluctuated about this matter, when it happened that a certain

deacon of the Roman Church, named Deusdona, arrived at the Court for the purpose of seeking the favour of the King in some affairs in which he was interested. He remained some time; and then having transacted his business, he was about to return to Rome when one day, moved by courtesy to a stranger, we invited him to a modest refection; and while talking of many things at table, mention was made of the translation of the body of the blessed Sebastian,[3] and of the neglected tombs of the [163] martyrs, of which there is such a prodigious number at Rome; and the conversation having turned towards the dedication of our new basilica, I began to inquire how it might be possible for me to obtain some of the true relics of the saints which rest at Rome. He at first hesitated, and declared that he did not know how that could be done. But observing that I was both anxious and curious about the subject, he promised to give me an answer some other day.

When I returned to the question some time afterwards, he immediately drew from his bosom a paper, which he begged me to read when I was alone, and to tell him what I was disposed to think of that which was therein stated. I took the paper and, as he desired, read it alone and in secret." (Cap.1, 2, 3.)

I shall have occasion to return to Deacon Deusdona's conditions, and to what happened after Eginhard's acceptance of them. Suffice it, for the present, to say that Eginhard's notary, Ratleicus (Ratleig), was despatched to Rome and succeeded in securing two bodies, supposed to be those of the holy martyrs Marcellinus and Petrus; and when he had got as far on his homeward journey as the Burgundian town of Solothurn, or Soleure,[4] notary Ratleig despatched to his master, at St. Bavon, a letter announcing the success of his mission.

"As soon as by reading it I was assured of the arrival of the saints, I despatched a confidential messenger to Maestricht to gather together priests, other clerics, and also laymen, to go out to meet the coming saints as speedily as possible. And he and his companions, having lost no time, after a few days met those who had charge of the saints at Solothurn. Joined with them, [164] and with a vast crowd of people who gathered from all parts, singing hymns, and amidst great and universal rejoicings, they travelled quickly to the city of Argentoratum, which is now called Strasburg. Thence embarking on the Rhine, they came to the place called Portus,[5] and landing on the east bank of the river, at the fifth station thence they arrived at Michilinstadt[6] accompanied by an immense multitude, praising God. This place is in that forest of Germany which in modern times is called the Odenwald, and about six leagues from the Maine. And here, having found a basilica recently built by me, but not yet consecrated, they carried the sacred remains into it and deposited them therein, as if it were to be their final resting-place. As soon as all this was reported to me I travelled thither as quickly as I could." (Cap. ii.14.)

Three days after Eginhard's arrival began the series of wonderful events which he narrates, and for which we have his personal guarantee. The first thing that he notices is the dream of a servant of Ratleig, the notary who, being set to watch the holy relics in the church after vespers, went to sleep and, during his slumbers, had a vision of two pigeons, one white and one gray and white, which came and sat upon the bier over the relics; while, at the same time, a voice ordered the man to tell his master that the holy martyrs had chosen another resting-place and desired to be transported thither without delay.

Unfortunately, the saints seem to have forgotten to mention where they wished to go; and, with the most anxious desire to gratify their [165] smallest wishes, Eginhard was naturally greatly perplexed what to do. While in this state of mind, he was one day contemplating his "great and wonderful treasure, more

precious than all the gold in the world," when it struck him that the chest in which the relics were contained was quite unworthy of its contents; and, after vespers, he gave orders to one of the sacristans to take the measure of the chest in order that a more fitting shrine might be constructed. The man, having lighted a wax candle and raised the pall which covered the relics, in order to carry out his master's orders, was astonished and terrified to observe that the chest was covered with a bloodlike exudation (*loculum mirum in modum humore sanguinco undique distillantem*), and at once sent a message to Eginhard.

"Then I and those priests who accompanied me beheld this stupendous miracle, worthy of all admiration. For just as when it is going to rain, pillars and slabs and marble images exude moisture, and, as it were, sweat, so the chest which contained the most sacred relics was found moist with the blood exuding on all sides." (Cap. ii. 16.)

Three days' fast was ordained in order that the meaning of the portent might be ascertained. All that happened, however, was that, at the end of that time, the "blood," which had been exuding in drops all the while, dried up. Eginhard is careful to say that the liquid "had a saline taste, something like that of tears, and was thin as water, [166] though of the colour of true blood," and he clearly thinks this satisfactory evidence that it was blood.

The same night, another servant had a vision, in which still more imperative orders for the removal of the relics were given; and, from that time forth, "not a single night passed without one, two, or even three of our companions receiving revelations in dreams that the bodies of the saints were to be transferred from that place to another." At last a priest, Hildfrid, saw, in a dream, a venerable white-haired man in a priest's vestments, who bitterly reproached Eginhard for not obeying the repeated orders of the saints; and, upon this, the journey was commenced. Why Eginhard delayed obedience to these repeated visions so long does not appear. He does not say so, in so many words, but the general tenor of the narrative leads one to suppose that Mulinheim (afterwards Seligenstadt) is the "solitary place" in which he had built the church which awaited dedication. In that case, all the people about him would know that he desired that the saints should go there. If a glimmering of secular sense led him to be a little suspicious about the real cause of the unanimity of the visionary beings who manifested themselves to his *entourage* in favour of moving on, he does not say so.

At the end of the first day's journey, the precious relics were deposited in the church of St. Martin, [167] in the village of Ostheim. Hither, a paralytic nun (*sanctinmonialis quædam paralytica*) of the name of Ruodlang was brought, in a car, by her friends and relatives from a monastery a league off. She spent the night watching and praying by the bier of the saints; "and health returning to all her members, on the morrow she went back to her place whence she came, on her feet, nobody supporting her, or in any way giving her assistance." (Cap. ii. 19.)

On the second day, the relics were carried to Upper Mulinheim; and, finally, in accordance with the orders of the martyrs, deposited in the church of that place, which was therefore renamed Seligenstadt. Here, Daniel, a beggar boy of fifteen, and so bent that "he could not look at the sky without lying on his back, "collapsed and fell down during the celebration of the Mass." Thus he lay a long time, as if asleep, and all his limbs straightening and his flesh strengthening *(recepta firmitate nervorum*), he arose before

our eyes, quite well." (Cap. ii. 20.)

Some time afterwards an old man entered the church on his hands and knees, being unable to use his limbs properly:–

"He, in presence of all of us, by the power of God and the merits of the blessed martyrs, in the same hour in which he entered was so perfectly cured that he walked without so much as a stick. And he said that, though he had been deaf for five years, his deafness had ceased along with the palsy." (Cap. iii. 33.)

[168] Eginhard was now obliged to return to the Court at Aix-la-Chapelle, where his duties kept him through the winter; and he is careful to point out that the later miracles which he proceeds to speak of are known to him only at second hand. But, as he naturally observes, having seen such wonderful events with his own eyes, why should he doubt similar narrations when they are received from trustworthy sources?

Wonderful stories these are indeed, but as they are, for the most part, of the same general character as those already recounted, they may be passed over. There is, however, an account of a possessed maiden which is worth attention. This is set forth in a memoir, the principal contents of which are the speeches of a demon who declared himself to possess the singular appellation of "Wiggo," and revealed himself in the presence of many witnesses, before the altar, close to the relics of the blessed martyrs. It is noteworthy that the revelations appear to have been made in the shape of replies to the questions of the exorcising priest; and there is no means of judging how far the answers are, really, only the questions to which the patient replied yes or no.

The possessed girl, about sixteen years of age, was brought by her parents to the basilica of the martyrs.

"When she approached the tomb containing the sacred bodies, the priest, according to custom, read the formula of exorcism [169] over her head. When he began to ask how and when the demon had entered her, she answered, not in the tongue of the barbarians, which alone the girl knew, but in the Roman tongue. And when the priest was astonished and asked how she came to know Latin, when her parents, who stood by, were wholly ignorant of it, 'Thou hast never seen my parents,' was the reply. To this the priest, 'Whence art thou, then, if these are not thy parents?' And the demon, by the mouth of the girl, 'I am a follower and disciple of Satan, and for a long time I was gatekeeper (janitor) in hell; but, for some years, along with eleven companions, I have ravaged the kingdom of the Franks.'" (Cap. v. 49.)

He then goes on to tell how they blasted the crops and scattered pestilence among beasts and men, because of the prevalent wickedness of the people.[7] The enumeration of all these iniquities, in oratorical style, takes up a whole octavo page; and at the end it is stated, "All these things the demon spoke in Latin by the mouth of the girl."

"And when the priest imperatively ordered him to come out, 'I shall go,' said he, 'not in obedience to you, but on account of the power of the saints, who do not allow me to remain any longer.' And, having said this, he threw the girl down on the floor and there compelled her to lie prostrate for a time, as though she slumbered. After a

little while, however, he going away, the girl, by the power of Christ and the merits of the blessed martyrs, as it were awakening from sleep, rose up quite well, to the astonishment of all present; nor after the demon had gone out was she able to speak Latin: so that it was plain enough that it was not she who had spoken in that tongue, but the demon by her mouth." (Cap. v.51.)

[170] If the "Historia Translationis" contained nothing more than has been laid before the reader, up to this time, disbelief in the miracles of which it gives so precise and full a record might well be regarded as hyper-scepticism. It might fairly be said, Here you have a man, whose high character, acute intelligence, and large instruction are certified by eminent contemporaries; a man who stood high in the confidence of one of the greatest rulers of any age, and whose other works prove him to be an accurate and judicious narrator of ordinary events. This man tells you, in language which bears the stamp of sincerity, of things which happened within his own knowledge, or within that of persons in whose veracity he has entire confidence, while he appeals to his sovereign and the court as witnesses of others; what possible ground can there be for disbelieving him?

Well, it is hard upon Eginhard to say so, but it is exactly the honesty and sincerity of the man which are his undoing as a witness to the miraculous. He himself makes it quite obvious that when his profound piety comes on the stage, his good sense and even his perception of right and wrong, make their exit. Let us go back to the point at which we left him, secretly perusing the letter of Deacon Deusdona. As he tells us, its contents were

"that he [the deacon] had many relics of saints at home, and that he would give them to me if I would furnish him with the [171] means of returning to Rome; he had observed that I had two mules, and if I would let him have one of them and would despatch with him a confidential servant to take charge of the relics, he would at once send them to me. This plausibly expressed proposition pleased me, and I made up my mind to test the value of the somewhat ambiguous promise at once;[8] so giving him the mule and money for his journey I ordered my notary Ratleig (who already desired to go to Rome to offer his devotions there) to go with him. Therefore, having left Aix-la-Chapelle (where the Emperor and his Court resided at the time) they came to Soissons. Here they spoke with Hildoin, abbot of the monastery of St. Medardus, because the said deacon had assured him that he had the means of placing in his possession the body of the blessed Tiburtius the Martyr. Attracted by which promises he (Hildoin) sent with them a certain priest, Hunus by name, a sharp man (*hominem callidum*) whom he ordered to receive and bring back the body of the martyr in question. And so, resuming their journey, they proceeded to Rome as fast as they could." (Cap. i. 3.)

Unfortunately, a servant of the notary, one Reginbald, fell ill of a tertian fever, and impeded the progress of the party. However, this piece of adversity had its sweet uses; for three days before they reached Rome, Reginbald had a vision. Somebody habited as a deacon appeared to him and asked why his master was in such a hurry to get to Rome; and when Reginbald explained their business, this visionary deacon, who seems to have taken the measure of his brother in the flesh with some accuracy, told him not by any means to [172] expect that Deusdona would fulfil his promises. Moreover, taking the servant by the hand, he led him to the top of a high mountain and, showing him Rome (where the man had never been), pointed out a church, adding "Tell Ratleig the thing he wants is hidden there; let him get it as quickly as he can and go back to his master." By way of a sign that the order was authoritative, the servant was promised that, from that time forth, his fever should disappear. And as the fever did vanish

to return no more, the faith of Eginhard's people in Deacon Deusdona naturally vanished with it (*et fidem diaconi promissis non haberent*). Nevertheless, they put up at the deacon's house near St. Peter ad Vincula. But time went on and no relics made their appearance, while the notary and the priest were put off with all sorts of excuses–the brother to whom the relics had been confided was gone to Beneventum and not expected back for some time, and so on–until Ratleig and Hunus began to despair, and were minded to return, *infecto negotio.*

"But my notary, calling to mind his servant's dream, proposed to his companion that they should go to the cemetery which their host had talked about without him. So, having found and hired a guide, they went in the first place to the basilica of the blessed Tiburtius in the Via Labicana, about three thousand paces from the town, and cautiously and carefully inspected the tomb of that martyr; in order to discover whether it could be opened without any one being the wiser. Then they descended into the adjoining crypt, in which the bodies of the blessed [173] martyrs of Christ, Marcellinus and Petrus, were buried; and, having made out the nature of their tomb, they went away thinking their host would not know what they had been about. But things fell out differently from what they had imagined." (Cap. i. 7.)

In fact, Deacon Deusdona, who doubtless kept an eye on his guests, knew all about their manœuvers and made haste to offer his services, in order that, "with the help of God" (*si Deus votis eorum favere dignaretur*), they should all work together. The deacon was evidently alarmed lest they should succeed without *his* help.

So, by way of preparation for the contemplated *vol avec effraction* they fasted three days; and then, at night, without being seen, they betook themselves to the basilica of St. Tiburtius, and tried to break open the altar erected over his remains. But the marble proving too solid, they descended to the crypt, and, "having evoked our Lord Jesus Christ and adored the holy martyrs," they proceeded to prise off the stone which covered the tomb, and thereby exposed the body of the most sacred martyr, Marcellinus, "whose head rested on a marble tablet on which his name was inscribed." The body was taken up with the greatest veneration, wrapped in a rich covering, and given over to the keeping of the deacon and his brother, Lunison, while the stone was replaced with such care that no sign of the theft remained.

[174] As sacrilegious proceedings of this kind were punishable with death by the Roman law, it seems not unnatural that Deacon Deusdona should have become uneasy, and have urged Ratleig to be satisfied with what he had got and be off with his spoils. But the notary having thus cleverly captured the blessed Marcellinus, thought it a pity he should be parted from the blessed Petrus, side by side with whom he had rested, for five hundred years and more, in the same sepulchre (as Eginhard pathetically observes); and the pious man could neither eat, drink, nor sleep, until he had compassed his desire to re-unite the saintly colleagues. This time, apparently in consequence of Deusdona's opposition to any further resurrectionist doings, he took counsel with a Greek monk, one Basil, and, accompanied by Hunus, but saying nothing to Deusdona, they committed another sacrilegious burglary, securing this time, not only the body of the blessed Petrus, but a quantity of dust, which they agreed the priest should take, and tell his employer that it was the remains of the blessed Tiburtius. How Deusdona was "squared," and what he got for his not very valuable complicity in these transactions, does not appear. But at last the relics were sent off in charge of Lunison, the brother of Deusdona, and the priest Hunus, as far as Pavia, while

Ratleig stopped behind for a week to see if the robbery was discovered, and, presumably, to act as a blind, if any hue and cry [175] was raised. But, as everything remained quiet, the notary betook himself to Pavia, where he found Lunison and Hunus awaiting his arrival. The notary's opinion of the character of his worthy colleagues, however, may be gathered from the fact that, having persuaded them to set out in advance along a road which he told them he was about to take, he immediately adopted another route, and, travelling by way of St. Maurice and the Lake of Geneva, eventually reached Soleure.

Eginhard tells all this story with the most naive air of unconsciousness that there is anything remarkable about an abbot, and a high officer of state to boot, being an accessory, both before and after the fact, to a most gross and scandalous act of sacrilegious and burglarious robbery. And an amusing sequel to the story proves that, where relics were concerned, his friend Hildoin, another high ecclesiastical dignitary, was even less scrupulous than himself.

On going to the palace early one morning, after the saints were safely bestowed at Seligenstadt, he found Hildoin waiting for an audience in the Emperor's antechamber, and began to talk to him about the miracle of the bloody exudation. In the course of conversation, Eginhard happened to allude to the remarkable fineness of the garment of the blessed Marcellinus. Whereupon Abbot Hildoin observed (to Eginhard's stupefaction) that his observation was quite correct. Much astonished [176] at this remark from a person who was supposed not to have seen the relics, Eginhard asked him how he knew that? Upon this, Hildoin saw that he had better make a clean breast of it, and he told the following story, which he had received from his priestly agent, Hunus. While Hunus and Lunison were at Pavia, waiting for Eginhard's notary, Hunus (according to his own account) had robbed the robbers. The relics were placed in a church; and a number of laymen and clerics, of whom Hunus was one, undertook to keep watch over them. One night, however, all the watchers, save the wide-awake Hunus, went to sleep; and then, according to the story which this "sharp" ecclesiastic foisted upon his patron,

"it was borne in upon his mind that there must be some great reason why all the people, except himself, had suddenly become somnolent; and, determining to avail himself of the opportunity thus offered (*oblata occasione utendum*), he rose and, having lighted a candle, silently approached the chests. Then, having burnt through the threads of the seals with the flame of the candle, he quickly opened the chests, which had no locks;[9] and, taking out portions of each of the bodies which were thus exposed, he closed the chests and connected the burnt ends of the threads with the seals again, so that they appeared not to have been touched; and, no one having seen him, he returned to his place." (Cap. iii. 23.)

Hildoin went on to tell Eginhard that Hunus at first declared to him that these purloined relics [177] belonged to St. Tiburtius; but afterwards confessed, as a great secret, how he had come by them, and he wound up his discourse thus:

"They have a place of honour beside St. Medardus, where they are worshipped with great veneration by all the people; but whether we may keep them or not is for your judgment." (Cap. iii. 23.)

Poor Eginhard was thrown into a state of great perturbation of mind by this revelation. An acquaintance of his had recently told him of a rumour that was spread about that Hunus had contrived to abstract *all*

the remains of SS. Marcellinus and Petrus while Eginhard's agents were in a drunken sleep; and that, while the real relics were in Abbot Hildoin's hands at St. Medardus, the shrine at Seligenstadt contained nothing but a little dust. Though greatly annoyed by this "execrable rumour, spread everywhere by the subtlety of the devil," Eginhard had doubtless comforted himself by his supposed knowledge of its falsity, and he only now discovered how considerable a foundation there was for the scandal. There was nothing for it but to insist upon the return of the stolen treasures. One would have thought that the holy man, who had admitted himself to be knowingly a receiver of stolen goods, would have made instant restitution and begged only for absolution. But Eginhard intimates that he had very great difficulty in getting his brother abbot to see that even restitution was necessary.

[178] Hildoin's proceedings were not of such a nature as to lead any one to place implicit confidence in anything he might say; still less had his agent, priest Hunus, established much claim to confidence; and it is not surprising that Eginhard should have lost no time in summoning his notary and Lunison to his presence, in order that he might hear what they had to say about the business. They, however, at once protested that priest Hunus's story was a parcel of lies, and that after the relics left Rome no one had any opportunity of meddling with them. Moreover, Lunison, throwing himself at Eginhard's feet, confessed with many tears what actually took place. It will be remembered that after the body of St. Marcellinus was abstracted from its tomb, Ratleig deposited it in the house of Deusdona, in charge of the latter's brother, Lunison. But Hunus, being very much disappointed that he could not get hold of the body of St. Tiburtius, and afraid to go back to his abbot empty-handed, bribed Lunison with four pieces of gold and five of silver to give him access to the chest. This Lunison did, and Hunus helped himself to as much as would fill a gallon measure (*vas sexani mensuram*) of the sacred remains. Eginhard's indignation at the "rapine" of this "nequissimus nebulo" is exquisitely droll. It would appear that the adage about the receiver being as bad as the thief was not current in the ninth century.

Let us now briefly sum up the history of the acquisition of the relics. Eginhard makes a contract with Deusdona for the delivery of certain relics which the latter says he possesses. Eginhard makes no inquiry how he came by them; otherwise, the transaction is innocent enough.

Deusdona turns out to be a swindler, and has no relics. Thereupon Eginhard's agent, after due fasting and prayer, breaks open the tombs and helps himself.

Eginhard discovers by the self-betrayal of his brother abbot, Hildoin, that portions of his relics have been stolen and conveyed to the latter. With much ado he succeeds in getting them back.

Hildoin's agent, Hunus, in delivering these stolen goods to him, at first declared they were the relics of St. Tiburtius, which Hildoin desired him to obtain; but afterwards invented a story of their being the product of a theft, which the providential drowsiness of his companions enabled him to perpetrate, from the relics which Hildoin well knew were the property of his friend.

Lunison, on the contrary, swears that all this story is false, and that he himself was bribed by Hunus to allow him to steal what he pleased from the property confided to his own and his brother's care by their

guest Ratleig. And the honest notary himself seems to have no hesitation about lying and stealing to any extent, where the acquisition of relics is the object in view.

[180] For a parallel to these transactions one must read a police report of the doings of a "long firm" or of a set of horse-coupers; yet Eginhard seems to be aware of nothing, but that he has been rather badly used by his friend Hildoin, and the "nequissimus nebulo" Hunus.

It is not easy for a modern Protestant, still less for any one who has the least tincture of scientific culture, whether physical or historical, to picture to himself the state of mind of a man of the ninth century, however cultivated, enlightened, and sincere he may have been. His deepest convictions, his most cherished hopes, were bound up with the belief in the miraculous. Life was a constant battle between saints and demons for the possession of the souls of men. The most superstitious among our modern countrymen turn to supernatural agencies only when natural causes seem insufficient; to Eginhard and his friends the supernatural was the rule; and the sufficiency of natural causes was allowed only when there was nothing to suggest others.

Moreover, it must be recollected that the possession of miracle-working relics was greatly coveted, not only on high, but on very low grounds. To a man like Eginhard, the mere satisfaction of the religious sentiment was obviously a powerful attraction. But, more than this, the possession of such a treasure was an immense practical advantage. If the saints were [181] duly flattered and worshipped, there was no telling what benefits might result from their interposition on your behalf. For physical evils, access to the shrine was like the grant of the use of a universal pill and ointment manufactory; and pilgrimages thereto might suffice to cleanse the performers from any amount of sin. A letter to Lupus, subsequently Abbot of Ferrara, written while Eginhard was smarting under the grief caused by the loss of his much-loved wife Imma, affords a striking insight into the current view of the relation between the glorified saints and their worshippers. The writer shows that he is anything but satisfied with the way in which he has been treated by the blessed martyrs whose remains he has taken such pains to "convey" to Seligenstadt, and to honour there as they would never have been honoured in their Roman obscurity.

"It is an aggravation of my grief and a reopening of my wound, that our vows have been of no avail, and that the faith which we placed in the merits and intervention of the martyrs has been utterly disappointed."

We may admit, then, without impeachment of Eginhard's sincerity, or of his honour under all ordinary circumstances, that when piety, self-interest, the glory of the Church in general, and that of the church at Seligenstadt in particular, all pulled one way, even the workaday principles of morality were disregarded; and, *a fortiori*, [182] anything like proper investigation of the reality of alleged miracles was thrown to the winds.

And if this was the condition of mind of such a man as Eginhard, what is it not legitimate to suppose may have been that of Deacon Deusdona, Lunison, Hunus, and Company, thieves and cheats by their own confession, or of the probably hysterical nun, or of the professional beggars, for whose incapacity to walk and straighten themselves there is no guarantee but their own? Who is to make sure that the

exorcist of the demon Wiggo was not just such another priest as Hunus; and is it not at least possible, when Eginhard's servants dreamed, night after night, in such a curiously coincident fashion, that a careful inquirer might have found they were very anxious to please their master?

Quite apart from deliberate and conscious fraud (which is a rarer thing than is often supposed), people, whose mythopœic faculty is once stirred, are capable of saying the thing that is not, and of acting as they should not, to an extent which is hardly imaginable by persons who are not so easily affected by the contagion of blind faith. There is no falsity so gross that honest men and, still more, virtuous women, anxious to promote a good cause, will not lend themselves to it without any clear consciousness of the moral bearings of what they are doing.

The cases of miraculously-effected cures of [183] which Eginhard is ocular witness appear to belong to classes of disease in which malingering is possible or hysteria presumable. Without modern means of diagnosis, the names given to them are quite worthless. One "miracle," however, in which the patient, a woman, was cured by the mere sight of the church in which the relics of the blessed martyrs lay, is an unmistakable case of dislocation of the lower jaw; and it is obvious that, as not unfrequently happens in such accidents in weakly subjects, the jaws slipped suddenly back into place, perhaps in consequence of a jolt, as the woman rode towards the church. (Cap. v. 53)[10]

There is also a good deal said about a very questionable blind man–one Albricus (Alberich?)–who, having been cured, not of his blindness, but of another disease under which he laboured, took up his quarters at Seligenstadt, and came out as a prophet, inspired by the Archangel Gabriel. Eginhard intimates that his prophecies were fulfilled; but as he does not state exactly what they were, or how they were accomplished, the statement must be accepted with much caution. It is obvious that he was not the man to hesitate to "ease" a prophecy until it fitted, if the credit of [184] the shrine of his favourite saints could be increased by such a procedure. There is no impeachment of his honour in the supposition. The logic of the matter is quite simple, if somewhat sophistical. The holiness of the church of the martyrs guarantees the reality of the appearance of the Archangel Gabriel there; and what the archangel says must be true. Therefore, if anything seem to be wrong, that must be the mistake of the transmitter; and, in justice to the archangel, it must be suppressed or set right. This sort of "reconciliation" is not unknown in quite modern times, and among people who would be very much shocked to be compared with a "benighted papist" of the ninth century.

The readers of this essay are, I imagine, very largely composed of people who would be shocked to be regarded as anything but enlightened Protestants. It is not unlikely that those of them who have accompanied me thus far may be disposed to say, "Well, this is all very amusing as a story, but what is the practical interest of it? We are not likely to believe in the miracles worked by the spolia of SS. Marcellinus and Petrus, or by those of any other saints in the Roman Calendar."

The practical interest is this: if you do not believe in these miracles recounted by a witness whose character and competency are firmly established, whose sincerity cannot be doubted, and who appeals to his sovereign and other contemporaries as witnesses of the truth of what he says, in a [185] document of

which a MS. copy exists, probably dating within a century of the author's death, why do you profess to believe in stories of a like character, which are found in documents of the dates and of the authorship of which nothing is certainly determined, and no known copies of which come within two or three centuries of the events they record? If it be true that the four Gospels and the Acts were written by Matthew, Mark, Luke, and John, all that we know of these persons comes to nothing in comparison with our knowledge of Eginhard; and not only is there no proof that the traditional authors of these works wrote them, but very strong reasons to the contrary may be alleged. If, therefore, you refuse to believe that "Wiggo" was cast out of the possessed girl on Eginhard's authority, with what justice can you profess to believe that the legion of devils were cast out of the man among the tombs of the Gadarenes? And if, on the other hand, you accept Eginhard's evidence, why do you laugh at the supposed efficacy of relics and the saint-worship of the modern Romanists? It cannot be pretended, in the face of all evidence, that the Jews of the year 30 A.D., or thereabouts, were less imbued with the belief in the supernatural than were the Franks of the year 800 A.D. The same influences were at work in each case, and it is only reasonable to suppose that the results were the same. If the evidence of Eginhard is insufficient to lead reason[186]able men to believe in the miracles he relates, *a fortiori* the evidence afforded by the Gospels and the Acts must be so.[11]

But it may be said that no serious critic denies the genuineness of the four great Pauline Epistles–Galatians, First and Second Corinthians, and Romans–and that in three out of these four Paul lays claim to the power of working miracles.[12] Must we suppose, therefore, that the Apostle to the Gentiles has stated that which is false? But to how much does this so-called claim amount? It may mean much or little. Paul nowhere tells us what he did in this direction; and in his sore need to justify his assumption of apostleship against the sneers of his enemies, it is hardly likely that, if he had any very striking cases to bring forward, he would have neglected evidence so well calculated to put them to shame. And, without the slightest impeachment of Paul's veracity, we must further remember that his strongly-marked mental characteristics, displayed in unmistakable fashion in these Epistles, are anything but those which would justify us in regarding him as a critical witness respecting matters of fact, or as a [187] trustworthy interpreter of their significance. When a man testifies to a miracle, he not only states a fact, but he adds an interpretation of the fact. We may admit his evidence as to the former, and yet think his opinion as to the latter worthless. If Eginhard's calm and objective narrative of the historical events of his time is no guarantee for the solidness of his judgment where the supernatural is concerned, the heated rhetoric of the Apostle of the Gentiles, his absolute confidence in the "inner light," and the extraordinary conceptions of the nature and requirements of logical proof which he betrays, in page after page of his Epistles, afford still less security.

There is a comparatively modern man who shared to the full Paul's trust in the "inner light," and who, though widely different from the fiery evangelist of Tarsus in various obvious particulars, yet, if I am not mistaken, shares his deepest characteristics. I speak of George Fox, who separated himself from the current Protestantism of England, in the seventeenth century, as Paul separated himself from the Judaism of the first century, at the bidding of the "inner light"; who went through persecutions as serious as those which Paul enumerates; who was beaten, stoned, cast out for dead, imprisoned nine times, sometimes for long periods; who was in perils on land and perils at sea. George Fox was an even more widely-travelled

missionary; while his success in founding [188] congregations, and his energy in visiting them, not merely in Great Britain and Ireland and the West India Islands, but on the continent of Europe and that of North America, were no less remarkable. A few years after Fox began to preach, there were reckoned to be a thousand Friends in prison in the various gaols of England; at his death, less than fifty years after the foundation of the sect, there were 70,000 Quakers in the United Kingdom. The cheerfulness with which these people–women as well as men–underwent martyrdom in this country and in the New England States is one of the most remarkable facts in the history of religion.

No one who reads the voluminous autobiography of "Honest George" can doubt the man's utter truthfulness; and though, in his multitudinous letters, he but rarely rises far above the incoherent commonplaces of a street preacher, there can be no question of his power as a speaker, nor any doubt as to the dignity and attractiveness of his personality, or of his possession of a large amount of practical good sense and governing faculty.

But that George Fox had full faith in his own powers as a miracle-worker, the following passage of his autobiography (to which others might be added) demonstrates:–

"Now after I was set at liberty from Nottingham gaol (where I had been kept a prisoner a pretty long time) I travelled as [189] before, in the work of the Lord. And coming to Mansfield Woodhouse, there was a distracted woman, under a doctor's hand, with her hair let loose all about her ears; and he was about to let her blood, she being first bound, and many people being about her, holding her by violence; but he could get no blood from her. And I desired them to unbind her and let her alone, for they could not touch the spirit in her by which she was tormented. So they did unbind her, and I was moved to speak to her, and in the name of the Lord to bid her be quiet and still. And she was so. And the Lord's power settled her mind and she mended; and afterwards received the truth and continued in it to her death. And the Lord's name was honoured; to whom the glory of all His works belongs. Many great and wonderful things were wrought by the heavenly power in those days. For the Lord made bare His omnipotent arm and manifested His power to the astonishment of many; by the healing virtue whereof many have been delivered from great infirmities, and the devils were made subject through His name: of which particular instances might be given beyond what this unbelieving age is able to receive or bear."[13]

It needs no long study of Fox's writings, however, to arrive at the conviction that the distinction between subjective and objective verities had not the same place in his mind as it has in that of an ordinary mortal. When an ordinary person would say "I thought so and so," or "I made up my mind to do so and so," George Fox says, "It was opened to me," or "at the command of God I did so and so." "Then at the command of God, on the ninth day of the seventh month 1643 (Fox being just nineteen), I left my relations and brake off all [190] familiarity or friendship with young or old." "About the beginning of the year 1647 I was moved of the Lord to go into Darbyshire." Fox hears voices and he sees visions, some of which he brings before the reader with apocalyptic power in the simple and strong English, alike untutored and undefiled, of which, like John Bunyan, his contemporary, he was a master.

"And one morning, as I was sitting by the fire, a great cloud came over me and a temptation beset me; and I sate still. And it was said, *All things come by Nature.* And the elements and stars came over me; so that I was in a manner quite clouded with it.... And as I sate still under it, and let it alone, a living hope

arose in me, and a true voice arose in me which said, *There is a living God who made all things.* And immediately the cloud and the temptation vanished away, and life rose over it all, and my heart was glad and I praised the living God" (p. 13).

If George Fox could speak, as he proves in this and some other passages he could write, his astounding influence on the contemporaries of Milton and of Cromwell is no mystery. But this modern reproduction of the ancient prophet, with his "Thus saith the Lord," "This is the work of the Lord," steeped in supernaturalism and glorying in blind faith, is the mental antipodes of the philosopher, founded in naturalism and a fanatic for evidence, to whom these affirmation inevitably [191] suggest the previous question: "How do you know that the Lord saith it?" "How do you know that the Lord doeth it?" and who is compelled to demand that rational ground for belief, without which, to the man of science, assent is merely an immoral pretence.

And it is this rational ground of belief which the writers of the Gospels, no less than Paul, and Eginhard, and Fox, so little dream of offering that they would regard the demand for it as a kind of blasphemy.

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[1] My citations are made from Teulet's *Einhardi omnia quæ extant opera*, Paris,1840-1843, which contains a biography of the author, a history of the text, with translations into French, and many valuable annotations.

[2] At present included in the Duchies of Hesse Darmstadt and Baden.

[3] This took place in the year 826 A.D. The relics were brought from Rome and deposited in the Church of St. Medardus at Soissons.

[4] Now included in Western Switzerland.

[5] Probably, according to Teulet, the present Sandhofer-fahrt, a little below the embouchure of the Neckar.

[6] The present Michilstadt, thirty miles N.E. of Heidelberg.

[7] In the Middle Ages one of the most favourite accusations against witches was that they committed just these enormities.

[8] It is pretty clear that Eginhard had his doubts about the deacon, whose pledges he qualifies *sponsiones incertæ.* But, to be sure, he wrote after events which fully justified scepticism.

[9] The words are *scrinia sine clave,* which seems to mean "having no key." But the circumstances forbid the idea of breaking open.

[10] Eginhard speaks with lofty contempt of the "vana ac superstitiosa præsumptio" of the poor woman's

companions in trying to alleviate her sufferings with "herbs and frivolous incantations." Vain enough, no doubt, but the "mulierculæ" might have returned the epithet "superstitions" with interest.

[11] Of course there is nothing new in this argument; but it does not grow weaker by age. And the case of Eginhard is far more instructive than that of Augustine, because the former has so very frankly, though incidentally, revealed to us not only his own mental and moral habits, but those of the people about him.

[12] See 1 Cor. xii, 10-28; 2 Cor. vi. 12; Rom. xv. 19.

[13] *A Journal or Historical Account of the Life, Travels, Sufferings, and Christian Experiences, &c., of George Fox.* Ed. 1694, pp. 27, 28.

THE HUXLEY FILE

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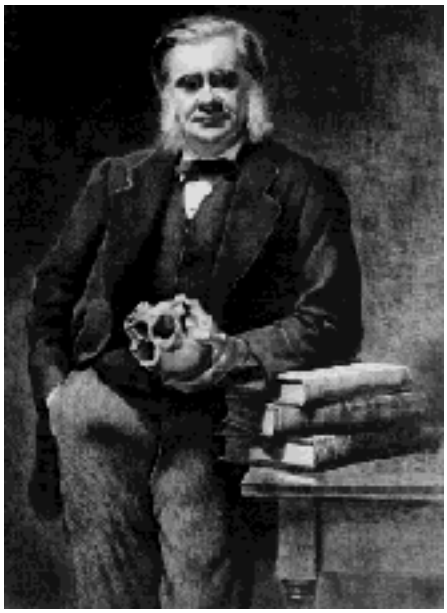

Possibilities and Impossibilities

Agnostic Annual (1892)

Collected Essays V

[192] IN the course of a discussion which has been going on during the last two years,[1] it has been maintained by the defenders of ecclesiastical Christianity that the demonology of the books of the New Testament is an essential and integral part of the revelation of the nature of the spiritual world promulgated by Jesus of Nazareth. Indeed if the historical accuracy of the Gospels and of the Acts of the Apostles is to be taken for granted, if the teachings of the Epistles are divinely inspired, and if the universal belief and practice of the primitive Church are the models which all later times must follow, there can be no doubt that those who accept the demonology are in the right. It is as plain as language can make it, that the writers of the Gospels believed in the existence [193] of Satan and the subordinate ministers of evil as strongly as they believed in that of God and the angels, and that they had an unhesitating faith in possession and in exorcism. No reader of the first three Gospels can hesitate to admit that, in the opinion of those persons among whom the traditions out of which they are compiled arose, Jesus held, and constantly acted upon, the same theory of the spiritual world. Nowhere do we find the slightest hint that he doubted the theory, or questioned the efficacy of the curative operations based upon it.

Thus, when such a story as that about the Gadarene swine is placed before us, the importance of the decision, whether it is to be accepted or rejected, cannot be overestimated. If the demonological part of it is to be accepted, the authority of Jesus is unmistakably pledged to the demonological system current in Judæa in the first century. The belief in devils who possess men and can be transferred from men to pigs, becomes as much a part of Christian dogma as any article of the creeds. If it is to be rejected, there are two alternative conclusions. Supposing the Gospels to be historically accurate, it follows that Jesus shared in the errors, respecting the nature of the spiritual world, prevalent in the age in which he lived and among the people of his nation. If, on the other hand, the Gospel traditions gives us only a popular version of the sayings and doings of [194] Jesus, falsely coloured and distorted by the superstitious imaginings of the minds through which it had passed, what guarantee have we that a similar unconscious falsification, in accordance with preconceived ideas, may not have taken place in respect of other reported sayings and doings? What is to prevent a conscientious inquirer from finding himself at last in a purely agnostic position with respect to the teachings of Jesus, and consequently with respect to the fundamentals of Christianity?

In dealing with the question whether the Gadarene story was to be believed or not, I confined myself altogether to a discussion of the value of the evidence in its favour. And, as it was easy to prove that this consists of nothing more than three partially discrepant, but often verbally coincident, versions of an original, of the authorship of which nobody knows anything, it appeared to me that it was wholly worthless. Even if the event described had been probable, such evidence would have required

corroboration; being grossly improbable, and involving acts questionable in their moral and legal aspect, the three accounts sank to the level of mere tales.

Thus far, I am unable, even after the most careful revision, to find any flaw in my argument; and I incline to think none has been found by my critics–at least, if they have, they have kept the discovery to themselves.

[195] In another part of my treatment of the case I have been less fortunate. I was careful to say that, for anything I could "absolutely prove to the contrary," there might be in the universe demonic beings who could enter into and possess men, and even be transferred from them to pigs; and that I, for my part, could not venture to declare *a priori* that the existence of such entities was "impossible." I was, however, no less careful to remark that I thought the evidence hitherto adduced in favour of the existence of such beings "ridiculously insufficient" to warrant the belief in them.

To my surprise, this statement of what, after the closest reflection, I still conceive to be the right conclusion, has been hailed as a satisfactory admission by opponents, and lamented as a perilous concession by sympathisers. Indeed, the tone of the comments of some candid friends has been such that I began to suspect that I must be entering upon a process of retrogressive metamorphosis which might eventually give me a place among the respectabilities. The prospect, perhaps, ought to have pleased me; but I confess I felt something of the uneasiness of the tailor who said that, whenever a customer's circumference was either much less, or much more, than at the last measurement, he at once sent in his bill; and I was not consoled until I recollected that, thirteen years ago, in discussing Hume's essay on [196] "Miracles," I had quoted, with entire assent, the following passage from his writings: "Whatever is intelligible and can be distinctly conceived implies no contradiction, and can never be proved false by any demonstrative argument or abstract reasoning *a priori*."[2]

Now, it is certain that the existence of demons can be distinctly conceived. In fact, from the earliest times of which we have any record to the present day, the great majority of mankind have had extremely distinct conceptions of them, and their practical life has been more or less shaped by those conceptions. Further, the notion of the existence of such beings "implies no contradiction." No doubt, in our experience, intelligence and volition are always found in connection with a certain material organisation, and never disconnected with it; while, by the hypothesis, demons have no such material substratum. But then, as everybody knows, the exact relation between mental and physical phenomena, even in ourselves, is the subject of endless dispute. We may all have our opinions as to whether mental phenomena have a substratum distinct from that which is assumed to underlie material phenomena, or not; though if any one thinks he has demonstrative evidence of either the existence or the non-existence of a "soul," all I can say is, his notion of [197] demonstration differs from mine. But, if it be impossible to demonstrate the non-existence of a "substance" of mental phenomena–that is, of a soul–independent of material "substance"; if the idea of such a "soul" is "intelligible and can be distinctly conceived," then it follows that it is not justifiable to talk of demons as "impossibilities." The idea of their existence implies no more "contradiction" than does the idea of the existence of pathogenic microbes in the air. Indeed, the microbes constitute a tolerably exact physical analogue of the "powers of the air" of ancient

belief.

Strictly speaking, I am unaware of any thing that has a right to the title of an "impossibility" except a contradiction in terms. There are impossibilities logical, but none natural. A "round square," a "present past," "two parallel lines that intersect," are impossibilities, because the ideas denoted by the predicates, *round, present, intersect,* are contradictory of the ideas denoted by the subjects, *squared, past, parallel.* But walking on water, or turning water into wine, or procreation without male intervention, or raising the dead, are plainly not "impossibilities" in this sense.

In the affirmation, that a man walked upon water, the idea of the subject is not contradictory of that in the predicate. Naturalists are familiar with insects which walk on water, and imagination has no more difficulty in putting a man in place of [198] the insect than it has in giving a man some of the attributes of a bird and making an angel of him; or in ascribing to him the ascensive tendencies of a balloon, as the "levitationists" do. Undoubtedly, there are very strong physical and biological arguments for thinking it extremely improbable that a man could be supported on the surface of the water as the insect is; or that his organization could be compatible with the possession and use of wings; or that he could rise through the air without mechanical aid. Indeed, if we have any reason to believe that our present knowledge of the nature of things exhausts the possibilities of nature, we might properly say that the attributes of men are contradictory of walking on water, or floating in the air, and consequently that these acts are truly "impossible" for him. But it is sufficiently obvious, not only that we are at the beginning of our knowledge of nature, instead of having arrived at the end of it, but that the limitations of our faculties are such that we never can be in a position to set bounds to the possibilities of nature. We have knowledge of what is happening and of what has happened; of what will happen we have and can have no more than expectation, grounded on our more or less correct reading of past experience and prompted by the faith, begotten of that experience, that the order of nature in the future will resemble its order in the past.

The same considerations apply to the other [199] examples of supposed miraculous events. The change of water into wine undoubtedly implies a contradiction, and is assuredly "impossible," if we are permitted to assume that the "elementary bodies" of the chemists are, now and for ever, immutable. Not only, however, is a negative proposition of this kind incapable of proof, but modern chemistry is inclining towards the contrary doctrine. And if carbon can be got out of hydrogen or oxygen, the conversion of water into wine comes within range of scientific possibility–it becomes a mere question of molecular arrangement.

As for virgin procreation, it is not only clearly imaginable, but modern biology recognizes it as an every-day occurrence among some groups of animals. So with restoration to life after death. Certain animals, long as dry as mummies, and, to all appearance, as dead, when placed in proper conditions resume their vitality. It may be said that these creatures are not dead, but merely in a condition of suspended vitality. That, however, is only begging the question by making the incapacity for restoration to life part of the definition of death. In the absence of obvious lesions of some of the more important organs, it is no easy matter, even for experts, to say that an apparently dead man is incapable of restoration to life; and, in the recorded instances of such restoration, the want of any conclusive evidence that the man [200] was dead is even more remarkable than the insufficiency of the testimony as to his coming to life again.

It may be urged, however, that there is, at any rate, one miracle certified by all three of the Synoptic Gospels which really does "imply a contradiction," and is, therefore, "impossible" in the strictest sense of the word. This is the well-known story of the feeding of several thousand men, to the complete satisfaction of their hunger, by the distribution of a few loaves and fishes among them; the wondrousness of this already somewhat surprising performance being intensified by the assertion that the quantity of the fragments of the meal, left over, amounted to much more than the original store.

Undoubtedly, if the operation is stated in its most general form; if it is to be supposed that a certain quantity, or magnitude, was divided into many more parts than the whole contained; and that, after the subtraction of several thousands of such parts, the magnitude of the remainder amounted to more than the original magnitude, there does seem to be an *a priori* difficulty about accepting the proposition, seeing that it appears to be contradictory of the senses which we attach to the words "whole" and "parts" respectively. But this difficulty is removed if we reflect that we are not, in this case, dealing with magnitude in the abstract, or with "whole" and "parts" in [201] their mathematical sense, but with concrete things, many of which are known to possess the power of growing, or increasing in magnitude. They thus furnish us with a conception of growth which we may, in imagination, apply to loaves and fishes; just as we may, in imagination, apply the idea of wings to the idea of a man. It must be admitted that a number of sheep might be fed on a pasture, and yet there might be more grass on the pasture, when the sheep left it, than there was at first. We may generalize this and other such facts into a perfectly definite conception of the increase of food in excess of consumption; which thus becomes a possibility, the limitations of which are to be discovered only by experience. Therefore, if it is asserted that cooked food has been made to grow in excess of rapid consumption, that statement cannot logically be rejected as an *a priori* impossibility, however improbable experience of the capabilities of cooked food may justify us in holding it to be.

On the strength of this undeniable improbability, however, we not only have a right to demand, but are morally bound to require, strong evidence in its favour before we even take it into serious consideration. But what is the evidence in this case? It is merely that of those three books,[3] which also concur in testifying to the truth [202] of the monstrous legend of the herd of swine. In these three books, there are five accounts of a "miraculous feeding," which fall into two groups. Three of the stories, obviously derived from some common source, state that five loaves and two fishes sufficed to feed five thousand persons, and that twelve baskets of fragments remained over. In the two others, also obviously derived from a commons source, distinct from the preceding, seven loaves and a few small fishes are distributed to four thousand persons, and seven baskets of fragments are left.

If we were dealing with secular records, I suppose no candid and competent student of history would entertain much doubt that the originals of the three stories and of the two are themselves merely divergent versions of some primitive story which existed before the three Synoptic gospels were compiled out of the body of traditions current about Jesus. This view of the case, however, is incompatible with a belief in the historical accuracy of the first and second gospels.[4] For these agree in making Jesus himself speak of both the "four thousand" and the "five thousand" miracle. "When I brake

the five loaves among the five thousand, how many baskets full of broken pieces took ye up? They say unto him twelve. And when the seven among the four [203] thousand, how many baskets full of broken pieces took ye up? And they say unto him, seven."

Thus we are face to face with a dilemma the way of escape from which is not obvious. Either the "four thousand" and the "five thousand" stories are both historically true, and describe two separate events; or the first and second gospels testify to the very words of a conversation between Jesus and his disciples which cannot have been uttered.

My choice between these alternatives is determined by no *a priori* speculations about the possibility or impossibility of such events as the feeding of the four or of the five thousand. But I ask myself the question, What evidence ought to be produced before I could feel justified in saying that I believed such an event to have occurred? That question is very easily answered. Proof must be given (1) of the weight of the loaves and fishes at starting; (2) of the distribution to 4-5,000 persons, without any additional supply, of this quantity and quality of food; (3) of the satisfaction of these people's appetites; (4) of the weight and quality of the fragments gathered up into the baskets. Whatever my present notions of probability and improbability may be, satisfactory testimony under these four heads would lead me to believe that they were erroneous; and I should accept the so-called miracle as a new and unexpected example of the possibilities of nature.

[204] But when, instead of such evidence, nothing is produced but two sets of discrepant stories, originating nobody knows how or when, among persons who could believe as firmly in devils which enter pigs, I confess that my feeling is one of astonishment that any one should expect a reasonable man to take such testimony seriously.

I am anxious to bring about a clear understanding of the difference between "impossibilities" and "improbabilities," because mistakes on this point lay us open to the attacks of ecclesiastical apologists of the type of the late Cardinal Newman; acute sophists, who think it fitting to employ their intellects, as burglars employ dark lanterns for the discovery of other people's weak places, while they carefully keep the light away from their own position.

When it is rightly stated, the Agnostic view of "miracles" is, in my judgment, unassailable. We are *not* justified in the *a priori* assertion that the order of nature, as experience has revealed it to us, cannot change. In arguing about the miraculous, the assumption is illegitimate, because it involves the whole point in dispute. Furthermore, it is an assumption which takes us beyond the range of our faculties. Obviously, no amount of past experience can warrant us in anything more than a correspondingly strong expectation for the present and future. We find, practically, that [205] expectations, based upon careful observations of past events, are, as a rule, trustworthy. We should be foolish indeed not to follow the only guide we have through life. But, for all that, our highest and surest generalizations remain on the level of justifiable expectations; that is, very high probabilities. For my part, I am unable to conceive of an intelligence shaped on the model of that of man, however superior it might be, which could be any better off than our own in this respect; that is, which could possess logically justifiable grounds for

certainty about the constancy of the order of things, and therefore be in a position to declare that such and such events are impossible. Some of the old mythologies recognised this clearly enough. Beyond and above Zeus and Odin, there lay the unknown and inscrutable Fate which, one day or other, would crumple up them and the world they ruled to give place to a new order of things.

I sincerely hope that I shall not be accused of Pyrrhonism, or of any desire to weaken the foundations of rational certainty. I have merely desired to point out that rational certainty is one thing, and talk about "impossibilities," or "violation of natural laws," another. Rational certainty rests upon two grounds–the one that the evidence in favour of a given statement is as good as it can be; the other that such evidence is plainly insufficient. In the former case, the statement is to be [206] taken as true, in the latter as untrue; until something arises to modify the verdict, which, however properly reached, may always be more or less wrong, the best information being never complete, and the best reasoning being liable to fallacy.

To quarrel with the uncertainty that besets us in intellectual affairs, would be about as reasonable as to object to live one's life, with due thought for the morrow, because no man can be sure he will be alive an hour hence. Such are the conditions imposed upon us by nature, and we have to make the best of them. And I think that the greatest mistake those of us who are interested in the progress of free thought can make is to overlook these limitations, and to deck ourselves with the dogmatic feathers which are the traditional adornment of our opponents. Let us be content with rational certainty, leaving irrational certainties to those who like to muddle their minds with them. I cannot see my way to say that demons are impossibilities; but I am not more certain about anything, than I am that the evidence tendered in favour of the demonology, of which the Gadarene story is a typical example, is utterly valueless. I cannot see my way to say that it is "impossible" that the hunger of thousands of men should be satisfied out of the food supplied by half-a-dozen loaves and a fish or two; but it seems to me monstrous that I should be asked to believe it on the faith of the five stories which testify to such an [207] occurrence. It is true that the position that miracles are "impossible" cannot be sustained. But I know of nothing which calls upon me to qualify the grave verdict of Hume: "There is not to be found, in all history, any miracle attested by a sufficient number of men, of such unquestioned goodness, education, and learning as to secure us against all delusion in themselves; of such undoubted integrity as to place them beyond all suspicion of any design to deceive others; of such credit and reputation in the eyes of mankind as to have a great deal to lose in case of their being detected in any falsehood; and at the same time attesting facts, performed in such a public manner, and in so celebrated a part of the world, as to render the detection unavoidable: *all which circumstances are requisite to give us a full assurance in the testimony of men.*"[5]

The preceding paper called forth the following criticism signed "Agnosco," to which I append my reply:–

"While agreeing generally with Professor Huxley's remarks respecting miracles, in 'The Agnostic Annual for 1892,' it has seemed to me that one of his arguments at least requires qualification. The Professor, in maintaining that so-called miraculous events are possible, although the evidence adduced is not sufficient to render them probable, refers to the possibility of changing water into wine by molecular re-composition. He tells us that, 'if carbon can be got out of hydrogen or oxygen, the conversion of water into wine comes within range of scientific possibility.' But in maintaining that miracles (so-called) have [208] a *prospective* possibility, Professor Huxley

loses sight–at least, so it appears to me–of the question of their *retrospective* possibility. For, if it requires a certain degree of knowledge and experience, yet far from having been attained, to perform those acts which have been called miraculous, it is not only improbable, but impossible likewise, that they should have been done by men whose knowledge and experience were considerably less than our own. It has seemed to me, in fact, that this question of the retrospective possibility of miracles is more important to us Rationalists, and, for the matter of that, to Christians also, than the question of their prospective possibility, with which Professor Huxley's article mainly deals. Perhaps the Professor himself could help those of us who think so, by giving us his opinion."

I am not sure that I fully appreciate the point raised by "Agnosco," nor the distinction between the prospective and the retrospective "possibility" of such a miracle as the conversion of water into wine. If we may contemplate such an event as "possible" in London in the year 1900, it must, in the same sense, have been "possible" in the year 30 (or thereabouts) at Cana in Galilee. If I should live so long, I shall take great interest in the announcement of the performance of this operation, say, nine years hence; and, if there is no objection raised by chemical experts, I shall accept the fact that the feat has been performed, without hesitation. But I shall have no more ground for believing the Cana story than I had before; simply because the evidence in its favour will remain, for me, exactly where it is. Possible or impossible, that evidence is worth nothing. To leave the safe ground of "no evidence" for speculations about impossibilities, consequent upon the want of scientific knowledge of the supposed workers of miracles, appears to me to be a mistake; especially in view of the orthodox contention that they possessed supernatural power and supernatural knowledge.

T. H. Huxley.

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[1] 1889-1891. See the next essay (VII) and those which follow it.

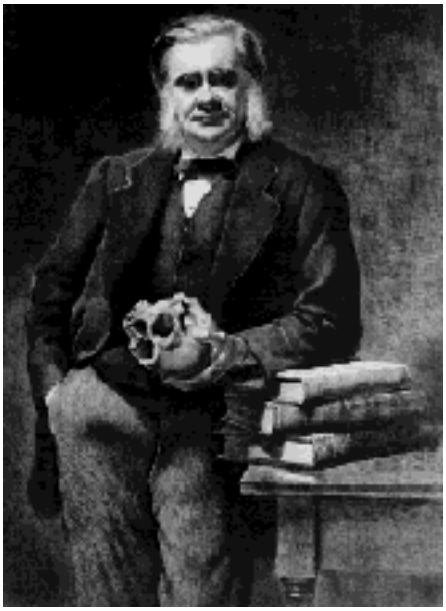
[2] *Inquiry Concerning the Human Understanding*, p. 5; 1748. The passage is cited and discussed in my *Hume*, pp. 132, 133.

[3] The story in John vi. 5-14 is obviously derived from the "five thousand" narrative of the Synoptics.

[4] Matthew xvi. 5-12; Mark viii. 14-21.

[5] Hume, *Inquiry*, sec. x., part ii.

THE HUXLEY FILE



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Active Skepticism

J. Huxley, *Diary of H. M. S. Rattlesnake*

Agnosticism (1889)

Collected Essays V

[209] Within the last few months, the public has received much and varied information on the subject of agnostics, their tenets, and even their future. Agnosticism exercised the orators of the Church Congress at Manchester.[1] It has been furnished with a set of "articles" fewer, but not less rigid, and certainly not less consistent than the thirty-nine; its nature has been analysed, and its future severely predicted by the most eloquent of that prophetical school whose Samuel is Auguste Comte. It may still be a question, however, whether the public is as much the wiser as might be expected, considering all the trouble that has been taken to enlighten it. Not only are the three accounts of the agnostic position sadly out of harmony with one another, but I [210] propose to show cause for my belief that all three must be seriously questioned by any one who employs the term "agnostic" in the sense in which it was originally used. The learned Principal of King's College, who brought the topic of Agnosticism before the Church Congress, took a short and easy way of settling the business:–

"But if this be so, for a man to urge, as an escape from this article of belief, that he has no means of a scientific knowledge of the unseen world, or of the future, is irrelevant. His difference from Christians lies not in the fact that he has no knowledge of these things, but that he does not believe the authority on which they are stated. He may prefer to call himself an Agnostic; but his real name is an older one–he is an infidel; that is to say, an unbeliever. The word infidel, perhaps, carries an unpleasant significance. Perhaps it is right that it should. It is, and it ought to be, an unpleasant thing for a man to have to say plainly that he does not believe in Jesus Christ."[2]

So much of Dr. Wace's address either explicitly or implicitly concerns me, that I take upon myself to deal with it; but, in so doing, it must be understood that I speak for myself alone. I am not aware that there is any sect of Agnostics; [211] and if there be, I am not its acknowledged prophet or pope. I desire to leave to the Comtists the entire monopoly of the manufacture of imitation ecclesiasticism.

Let us calmly and dispassionately consider Dr. Wace's appreciation of agnosticism. The agnostic, according to his view, is a person who says he has no means of attaining a scientific knowledge of the unseen world or of the future; by which somewhat loose phraseology Dr. Wace presumably means the theological unseen world and future. I cannot think this description happy, either in form or substance, but for the present it may pass. Dr. Wace continues, that is not "his difference from Christians." Are there then any Christians who say that they know nothing about the unseen world and the future? I was ignorant of the fact, but I am ready to accept it on the authority of a professional theologian, and I proceed to Dr. Wace's next proposition.

The real state of the case, then, is that the agnostic "does not believe the authority" on which "these things" are stated, which authority is Jesus Christ. He is simply an old-fashioned "infidel" who is afraid to own to his right name. As "Presbyter is priest writ large," so is "agnostic" the mere Greek equivalent for the Latin "infidel." There is an attractive simplicity about this solution of the problem; and it has that advantage of being somewhat offensive to the [212] persons attacked, which is so dear to the less refined sort of controversialist. The agnostic says, "I cannot find good evidence that so and so is true." "Ah," says his adversary, seizing his opportunity, "then you declare that Jesus Christ was untruthful, for he said so and so;" a very telling method of rousing prejudice. But suppose that the value of the evidence as to what Jesus may have said and done, and as to the exact nature and scope of his authority, is just that which the agnostic finds it most difficult to determine. If I venture to doubt that the Duke of Wellington gave the command "Up, Guards, and at 'em!" at Waterloo, I do not think that even Dr. Wace would accuse me of disbelieving the Duke. Yet it would be just as reasonable to do this as to accuse any one of denying what Jesus said, before the preliminary question as to what he did say is settled.

Now, the question as to what Jesus really said and did is strictly a scientific problem, which is capable of solution by no other methods than those practised by the historian and the literary critic. It is a problem of immense difficulty, which has occupied some of the best heads in Europe for the last century; and it is only of late years that their investigations have begun to converge towards one conclusion.[3]

[213] That kind of faith which Dr. Wace describes and lauds is of no use here. Indeed, he himself takes pains to destroy its evidential value.

"What made the Mahommedan world? Trust and faith in the declarations and assurances of Mahommed. And what made the Christian world? Trust and faith in the declarations and assurances of Jesus Christ and His Apostles" (*l.c.* p. 253). The triumphant tone of this imaginary catechism leads me to suspect that its author has hardly appreciated its full import. Presumably, Dr. Wace regards Mahommed as an unbeliever, or, to use the term which he prefers, infidel; and considers that his assurances have given rise

to a vast delusion which has led, and is leading, millions of men straight to everlasting punishment. And this being so, the "Trust and faith" which have "made the Mahommedan world," in just the same sense as they have [214] "made the Christian world," must be trust and faith in falsehood. No man who has studied history, or even attended to the occurrences of everyday life, can doubt the enormous practical value of trust and faith; but as little will he be inclined to deny that this practical value has not the least relation to the reality of the objects of that trust and faith. In examples of patient constancy of faith and of unswerving trust, the "Acta Martyrum" do not excel the annals of Babism.[4]

The discussion upon which we have now entered goes so thoroughly to the root of the whole matter; the question of the day is so completely, as the author of "Robert Elsmere" says, the value of testimony, that I shall offer no apology for following it out somewhat in detail; and, by way of giving substance to the argument, I shall base what I have to say upon a case, the consideration of which lies strictly within the province of natural science, and of that particular part of it known as the physiology and pathology of the nervous system.

I find, in the second Gospel (chap. v.), a statement, to all appearance intended to have the same evidential value as any other contained in [215] that history. It is the well-known story of the devils who were cast out of a man, and ordered, or permitted, to enter into a herd of swine, to the great loss and damage of the innocent Gerasene, or Gadarene, pig owners. There can be no doubt that the narrator intends to convey to his readers his own conviction that this casting out and entering in were effected by the agency of Jesus of Nazareth; that, by speech and action, Jesus enforced this conviction; nor does any inkling of the legal and moral difficulties of the case manifest itself.

On the other hand, everything that I know of physiological and pathological science leads me to entertain a very strong conviction that the phenomena ascribed to possession are as purely natural as those which constitute small-pox; everything that I know of anthropology leads me to think that the belief in demons and demoniacal possession is a mere survival of a once universal superstition, and that its persistence, at the present time, is pretty much in the inverse ratio of the general instruction, intelligence, and sound judgment of the population among whom it prevails. Everything that I know of law and justice convinces me that the wanton destruction of other people's property is a misdemeanour of evil example. Again, the study of history, and especially of that of the fifteenth, sixteenth, and seventeenth centuries, leaves no shadow of doubt [216] on my mind that the belief in the reality of possession and of witchcraft, justly based, alike by Catholics and Protestants, upon this and innumerable other passages in both the Old and New Testaments, gave rise, through the special influence of Christian ecclesiastics, to the most horrible persecutions and judicial murders of thousands upon thousands of innocent men, women, and children. And when I reflect that the record of a plain and simple declaration upon such an occasion as this, that the belief in witchcraft and possession is wicked nonsense, would have rendered the long agony of mediæval humanity impossible, I am prompted to reject, as dishonouring, the supposition that such declaration was withheld out of condescension to popular error.

"Come forth, thou unclean spirit, out of the man" (Mark v. 8),[5] are the words attributed to Jesus. If I declare, as I have no hesitation in doing, that I utterly disbelieve in the existence of "unclean spirits,"

and, consequently, in the possibility of their "coming forth" out of a man, I suppose that Dr. Wace will tell me I am disregarding the testimony "of our Lord." For, if these words were really used, the most resourceful of reconcilers can hardly venture to affirm that they are compatible with a disbelief "in these things." As the learned and [217] fair-minded, as well as orthodox, Dr. Alexander remarks, in an editorial note to the article "Demoniacs," in the "Biblical Cyclopædia" (vol. i. p. 664, note):–

". . .On the lowest grounds on which our Lord and His Apostles can be placed they must, at least, be regarded as *honest* men. Now, though honest speech does not require that words should be used always and only in their etymological sense, it does require that they should not be used so as to affirm what the speaker knows to be false. Whilst, therefore, our Lord and His Apostles might use the word [to be possessed by a demon], or the phrase, [to have a demon], as a popular description of certain diseases, without giving in to the belief which lay at the source of such a mode of expression, they could not speak of demons entering into a man, or being cast out of him, without pledging themselves to the belief of an actual possession of the man by the demons. (Campbell, *Prel. Diss.* vi. 1, 10). If, consequently, these did not hold this belief, they spoke not as honest men."

The story which we are considering does not rest on the authority of the second Gospel alone. The third confirms the second, especially in the matter of commanding the unclean spirit to come out of the man (Luke viii. 29); and, although the first Gospel either gives a different version of the same story, or tells another of like kind, the essential point remains: "If thou cast us out, send us away into the herd of swine. And He said unto them: Go!" (Matt. viii. 31, 32).

If the concurrent testimony of the three synoptics, then, is really sufficient to do away with all rational doubt as to a matter of fact of the utmost practical and speculative importance–[218] belief or disbelief in which may affect, and has affected, men's lives and their conduct towards other men, in the most serious way–then I am bound to believe that Jesus implicitly affirmed himself to possess a "knowledge of the unseen world," which afforded full confirmation of the belief in demons and possession current among his contemporaries. If the story is true, the mediæval theory of the invisible world may be and probably is, quite correct; and the witchfinders, from Sprenger to Hopkins and Mather, are much-maligned men.

On the other hand, humanity, noting the frightful consequences of this belief; common sense, observing the futility of the evidence on which it is based, in all cases that have been properly investigated; science, more and more seeing its way to inclose all the phenomena of so-called "possession" within the domain of pathology, so far as they are not to be relegated to that of the police–all these powerful influences concur in warning us, at our peril, against accepting the belief without the most careful scrutiny of the authority on which it rests.

I can discern no escape from this dilemma: either Jesus said what he is reported to have said, or he did not. In the former case, it is inevitable that his authority on matters connected with the "unseen world" should be roughly shaken; in the latter, the blow falls upon the [219] authority of the synoptic Gospels. If their report on a matter of such stupendous and far-reaching practical import as this is untrustworthy, how can we be sure of its trustworthiness in other cases? The favourite "earth," in which the hard-pressed reconciler takes refuge, that the Bible does not profess to teach science,[6] is stopped in this

instance. For the question of the existence of demons and of possession by them, though it lies strictly within the province of science, is also of the deepest moral and religious significance. If physical and mental disorders are caused by demons, Gregory of Tours and his contemporaries rightly considered that relics and exorcists were more useful than doctors; the gravest questions arise as to the legal and moral responsibilities of persons inspired by demoniacal impulses; and our whole conception of the universe and of our [220] relations to it becomes totally different from what it would be on the contrary hypothesis.

The theory of life of an average mediæval Christian was as different from that of an average nineteenth-century Englishman as that of a West African negro is now, in these respects. The modern world is slowly, but surely, shaking off these and other monstrous survivals of savage delusions; and, whatever happens, it will not return to that wallowing in the mire. Until the contrary is proved, I venture to doubt whether, at this present moment, any Protestant theologian, who has a reputation to lose, will say that he believes the Gadarene story.

The choice then lies between discrediting those who compiled the Gospel biographies and disbelieving the Master, whom they, simple souls, thought to honour by preserving such traditions of the exercise of his authority over Satan's invisible world. This is the dilemma. No deep scholarship, nothing but a knowledge of the revised version (on which it is to be supposed all that mere scholarship can do has been done), with the application thereto of the commonest canons of common sense, is needful to enable us to make a choice between its alternatives. It is hardly doubtful that the story, as told in the first Gospel, is merely a version of that told in the second and third. Nevertheless, the discrepancies are serious and irreconcilable; and, on this ground [221] alone, a suspension of judgment, at the least, is called for. But there is a great deal more to be said. From the dawn of scientific biblical criticism until the present day, the evidence against the long-cherished notion that the three synoptic Gospels are the works of three independent authors, each prompted by Divine inspiration, has steadily accumulated, until, at the present time, there is no visible escape from the conclusion that each of the three is a compilation consisting of a groundwork common to all three–the threefold tradition; and of a superstructure, consisting, firstly, of matter common to it with one of the others, and, secondly, of matter special to each. The use of the terms "groundwork" and "superstructure" by no means implies that the latter must be of later date than the former. On the contrary, some parts of it may be, and probably are, older than some parts of the groundwork.[7]

The story of the Gadarene swine belongs to the groundwork; at least, the essential part of it, in which the belief in demoniac possession is expressed, does; and therefore the compilers of the first, second, and third Gospels, whoever they [222] were, certainly accepted that belief (which, indeed, was universal among both Jews and pagans at that time), and attributed it to Jesus.

What, then, do we know about the originator, or originators, of this groundwork–of that threefold tradition which all three witnesses (in Paley's phrase) agree upon–that we should allow their mere statements to outweigh the counter arguments of humanity, of common sense, of exact science, and to imperil the respect which all would be glad to be able to render to their Master?

Absolutely nothing.[8] There is no proof, nothing more than a fair presumption, that any one of the Gospels existed, in the state in which we find it in the authorised version of the Bible, before the second century, or, in other words, sixty or seventy years after the events recorded. And, between that time and the date of the oldest extant manuscripts of the Gospels, there is no telling what additions and alterations and interpolations may have been made. It may be said that this is all mere speculation, but it is a good deal more. As competent scholars and honest men, our revisers have felt compelled to point out that such things have happened even [223] since the date of the oldest known manuscripts. The oldest two copies of the second Gospel end with the 8th verse of the 16th chapter; the remaining twelve verses are spurious, and it is noteworthy that the maker of the addition has not hesitated to introduce a speech in which Jesus promises his disciples that "in My name shall they cast out devils."

The other passage "rejected to the margin" is still more instructive. It is that touching apologue, with its profound ethical sense, of the woman taken in adultery–which, if internal evidence were an infallible guide, might well be affirmed to be a typical example of the teachings of Jesus. Yet, say the revisers, pitilessly, "Most of the ancient authorities emit John vii. 53-viii. 11." Now let any reasonable man ask himself this question. If, after an approximate settlement of the canon of the New Testament, and even later than the fourth and fifth centuries, literary fabricators had the skill and the audacity to make such additions and interpolations as these, what may they have done when no one had thought of a canon; when oral tradition, still unfixed, was regarded as more valuable than such written records as may have existed in the latter portion of the first century? Or, to take the other alternative, if those who gradually settled the canon did not know of the existence of the oldest codices which have come down to us; or if, [224] knowing them, they rejected their authority, what is to be thought of their competency as critics of the text?

People who object to free criticism of the Christian Scriptures forget that they are what they are in virtue of very free criticism; unless the advocates of inspiration are prepared to affirm that the majority of influential ecclesiastics during several centuries were safeguarded against error. For, even granting that some books of the period were inspired, they were certainly few amongst many; and those who selected the canonical books, unless they themselves were also inspired, must be regarded in the light of mere critics, and, from the evidence they have left of their intellectual habits, very uncritical critics. When one thinks that such delicate questions as those involved fell into the hands of men like Papias (who believed in the famous millenarian grape story); of Irenæus with his "reasons" for the existence of only four Gospels; and of such calm and dispassionate judges as Tertullian, with his "Credo quia impossibile ": the marvel is that the selection which constitutes our New Testament is as free as it is from obviously objectionable matter. The apocryphal Gospels certainly deserve to be apocryphal; but one may suspect that a little more critical discrimination would have enlarged the Apocrypha not inconsiderably,

At this point a very obvious objection arises [225] and deserves full and candid consideration. It may be said that critical scepticism carried to the length suggested is historical pyrrhonism; that if we are altogether to discredit an ancient or a modern historian, because he has assumed fabulous matter to be true, it will be as well to give up paying any attention to history. It may be said, and with great justice, that Eginhard's "Life of Charlemagne" is none the less trustworthy because of the astounding revelation

of credulity, of lack of judgment, and even of respect for the eighth commandment, which he has unconsciously made in the "History of the Translation of the Blessed Martyrs Marcellinus and Paul." Or, to go no further back than the last number of the *Nineteenth Century*, surely that excellent lady, Miss Strickland, is not to be refused all credence, because of the myth about the second James's remains, which she seems to have unconsciously invented.

Of course this is perfectly true. I am afraid there is no man alive whose witness could be accepted, if the condition precedent were proof that he had never invented and promulgated a myth. In the minds of all of us there are little places here and there, like the indistinguishable spots on a rock which give foothold to moss or stonecrop; on which, if the germ of a myth fall, it is certain to grow, without in the least degree affecting our accuracy or truthfulness elsewhere. Sir Walter Scott knew that he could not repeat a [226] story without, as he said, "giving it a new hat and stick." Most of us differ from Sir Walter only in not knowing about this tendency of the mythopœic faculty to break out unnoticed. But it is also perfectly true that the mythopœic faculty is not equally active in all minds, nor in all regions and under all conditions of the same mind. David Hume was certainly not so liable to temptation as the Venerable Bede, or even as some recent historians who could be mentioned; and the most imaginative of debtors, if he owes five pounds, never makes an obligation to pay a hundred out of it. The rule of common sense is *prima facie* to trust a witness in all matters, in which neither his self-interest, his passions, his prejudices, nor that love of the marvellous, which is inherent to a greater or less degree in all mankind, are strongly concerned; and, when they are involved, to require corroborative evidence in exact proportion to the contravention of probability by the thing testified.

Now, in the Gadarene affair, I do not think I am unreasonably sceptical, if I say that the existence of demons who can be transferred from a man to a pig, does thus contravene probability. Let me be perfectly candid. I admit I have no *a priori* objection to offer. There are physical things, such as *tæniæ* and *trichinæ*, which can be transferred from men to pigs, and *vice versa*, and which do undoubtedly produce most diabolical [227] and deadly effects on both. For anything I can absolutely prove to the contrary, there may be spiritual things capable of the same transmigration, with like effects. Moreover I am bound to add that perfectly truthful persons, for whom I have the greatest respect, believe in stories about spirits of the present day, quite as improbable as that we are considering.

So I declare, as plainly as I can, that I am unable to show cause why these transferable devils should not exist; nor can I deny that, not merely the whole Roman Church, but many Wacean "infidels" of no mean repute, do honestly and firmly believe that the activity of such like demonic beings is in full swing in this year of grace 1889.

Nevertheless, as good Bishop Butler says, "probability is the guide of life;" and it seems to me that this is just one of the cases in which the canon of credibility and testimony, which I have ventured to lay down, has full force. So that, with the most entire respect for many (by no means for all) of our witnesses for the truth of demonology, ancient and modern, I conceive their evidence on this particular matter to be ridiculously insufficient to warrant their conclusion.[9]

[228] After what has been said, I do not think that any sensible man, unless he happen to be angry, will accuse me of "contradicting the Lord and His Apostles" if I reiterate my total disbelief in the whole Gadarene story. But, if that story is discredited, all the other stories of demoniac possession fall under suspicion. And if the belief in demons and demoniac possession, which forms the sombre background of the whole picture of primitive Christianity, presented to us in the New Testament, is shaken, what is to be said, in any case, of the uncorroborated testimony of the Gospels with respect to "the unseen world"?

I am not aware that I have been influenced by any more bias in regard to the Gadarene story than I have been in dealing with other cases of like kind the investigation of which has interested me. I was brought up in the strictest school of evangelical orthodoxy; and when I was old enough to think for myself, I started upon my journey of inquiry with little doubt about the general truth of what I had been taught; and with that feeling [229] of the unpleasantness of being called an "infidel" which, we are told, is so right and proper. Near my journey's end, I find myself in a condition of something more than mere doubt about these matters.

In the course of other inquiries, I have had to do with fossil remains which looked quite plain at a distance, and became more and more indistinct as I tried to define their outline by close inspection. There was something there–something which, if I could win assurance about it, might mark a new epoch in the history of the earth; but, study as long as I might, certainty eluded my grasp. So has it been with me in my efforts to define the grand figure of Jesus as it lies in the primary strata of Christian literature. Is he the kindly, peaceful Christ depicted in the Catacombs? Or is he the stern Judge who frowns above the altar of SS. Cosmas and Damianus? Or can he be rightly represented by the bleeding ascetic, broken down by physical pain, of too many mediæval pictures? Are we to accept the Jesus of the second, or the Jesus of the fourth Gospel, as the true Jesus? What did he really say and do; and how much that is attributed to him, in speech and action, is the embroidery of the various parties into which his followers tended to split themselves within twenty years of his death, when even the threefold tradition was only nascent?

[230] If any one will answer these questions for me with something more to the point than feeble talk about the "cowardice of agnosticism," I shall be deeply his debtor. Unless and until they are satisfactorily answered, I say of agnosticism in this matter, "*J'y suis, et j'y reste.*"

But, as we have seen, it is asserted that I have no business to call myself an agnostic; that, if I am not a Christian I am an infidel; and that I ought to call myself by that name of "unpleasant significance." Well, I do not care much what I am called by other people, and if I had at my side all those who, since the Christian era, have been called infidels by other folks, I could not desire better company. If these are my ancestors, I prefer, with the old Frank, to be with them wherever they are. But there are several points in Dr. Wace's contention which must be elucidated before I can even think of undertaking to carry out his wishes. I must, for instance, know what a Christian is. Now what is a Christian? By whose authority is the signification of that term defined? Is there any doubt that the immediate followers of Jesus, the "sect of the Nazarenes," were strictly orthodox Jews differing from other Jews not more than the Sadducees, the Pharisees, and the Essenes differed from one another; in fact, only in the belief that the Messiah, for whom the rest of their nation waited, had come? Was not their chief, "James, the brother of the

Lord," [231] reverenced alike by Sadducee, Pharisee, and Nazarene? At the famous conference which, according to the Acts, took place at Jerusalem, does not James declare that "myriads" of Jews, who, by that time, had become Nazarenes, were "all zealous for the Law"? Was not the name of "Christian" first used to denote the converts to the doctrine promulgated by Paul and Barnabas at Antioch? Does the subsequent history of Christianity leave any doubt that, from this time forth, the "little rift within the lute" caused by the new teaching, developed, if not inaugurated, at Antioch, grew wider and wider, until the two types of doctrine irreconcilably diverged? Did not the primitive Nazarenism, or Ebionism, develop into the Nazarenism, and Ebionism, and Elkasaitism of later ages, and finally die out in obscurity and condemnation, as damnable heresy; while the younger doctrine throve and pushed out its shoots into that endless variety of sects, of which the three strongest survivors are the Roman and Greek Churches and modern Protestantism?

Singular state of things! If I were to profess the doctrine which was held by "James, the brother of the Lord," and by every one of the "myriads" of his followers and co-religionists in Jerusalem up to twenty or thirty years after the Crucifixion (and one knows not how much later at Pella), I should be condemned, with unanimity, as an ebionising heretic by the Roman, Greek, and [232] Protestant Churches! And, probably, this hearty and unanimous condemnation of the creed, held by those who were in the closest personal relation with their Lord, is almost the only point upon which they would be cordially of one mind. On the other hand, though I hardly dare imagine such a thing, I very much fear that the "pillars" of the primitive Hierosolymitan Church would have considered Dr. Wace an infidel. No one can read the famous second chapter of Galatians and the book of Revelation without seeing how narrow was even Paul's escape from a similar fate. And, if ecclesiastical history is to be trusted, the thirty-nine articles, be they right or wrong, diverge from the primitive doctrine of the Nazarenes vastly more than even Pauline Christianity did.

But, further than this, I have great difficulty in assuring myself that even James, "the brother of the Lord," and his "myriads" of Nazarenes, properly represented the doctrines of their Master. For it is constantly asserted by our modern "pillars" that one of the chief features of the work of Jesus was the instauration of Religion by the abolition of what our sticklers for articles and liturgies, with unconscious humour, call the narrow restrictions of the Law. Yet, if James knew this, how could the bitter controversy with Paul have arisen; and why did not one or the other side quote any of the various sayings of [233] Jesus, recorded in the Gospels, which directly bear on the question–sometimes, apparently, in opposite directions?

So, if I am asked to call myself an "infidel," I reply: To what doctrine do you ask me to be faithful? Is it that contained in the Nicene and the Athanasian Creeds? My firm belief is that the Nazarenes, say of the year 40, headed by James, would have stopped their ears and thought worthy of stoning the audacious man who propounded it to them. Is it contained in the so-called Apostles' Creed? I am pretty sure that even that would have created a recalcitrant commotion at Pella in the year 70, among the Nazarenes of Jerusalem, who had fled from the soldiers of Titus. And yet, if the unadulterated tradition of the teachings of "the Nazarene" were to be found anywhere, it surely should have been amidst those not very aged disciples who may have heard them as they were delivered.

Therefore, however sorry I may be to be unable to demonstrate that, if necessary, I should not be afraid to call myself an "infidel," I cannot do it. "Infidel" is a term of reproach, which Christians and Mahommedans, in their modesty, agree to apply to those who differ from them. If he had only thought of it, Dr. Wace might have used the term "miscreant," which, with the same etymological signification, has the advantage of being still more "unpleasant" to the persons to whom [234] it is applied. But why should a man be expected to call himself a "miscreant" or an "infidel"? That St. Patrick "had two birthdays because he was a twin" is a reasonable and intelligible utterance beside that of the man who should declare himself to be an infidel, on the ground of denying his own belief. It may be logically, if not ethically, defensible that a Christian should call a Mahommedan an infidel and *vice versa;* but, on Dr. Wace's principles, both ought to call themselves infidels, because each applies the term to the other.

Now I am afraid that all the Mahommedan world would agree in reciprocating that appellation to Dr. Wace himself. I once visited the Hazar Mosque, the great University of Mahommedanism, in Cairo, in ignorance of the fact that I was unprovided with proper authority. A swarm of angry undergraduates, as I suppose I ought to call them, came buzzing about me and my guide; and if I had known Arabic, I suspect that "dog of an infidel" would have been by no means the most "unpleasant" of the epithets showered upon me, before I could explain and apologise for the mistake. If I had had the pleasure of Dr. Wace's company on that occasion, the undiscriminative followers of the Prophet would, I am afraid, have made no difference between us; not even if they had known that he was the head of an orthodox Christian seminary. And I have not the smallest [235] doubt that even one of the learned mollahs, if his grave courtesy would have permitted him to say anything offensive to men of another mode of belief, would have told us that he wondered we did not find it "very unpleasant" to disbelieve in the Prophet of Islam.

From what precedes, I think it becomes sufficiently clear that Dr. Wace's account of the origin of the name of "Agnostic" is quite wrong. Indeed, I am bound to add that very slight effort to discover the truth would have convinced him that, as a matter of fact, the term arose otherwise. I am loath to go over an old story once more; but more than one object which I have in view will be served by telling it a little more fully than it has yet been told.

Looking back nearly fifty years, I see myself as a boy, whose education has been interrupted, and who, intellectually, was left, for some years, altogether to his own devices. At that time, I was a voracious and omnivorous reader; a dreamer and speculator of the first water, well endowed with that splendid courage in attacking any and every subject, which is the blessed compensation of youth and inexperience. Among the books and essays, on all sorts of topics from metaphysics to heraldry, which I read at this time, two left indelible impressions on my mind. One was Guizot's "History of Civilisation," the other was Sir William Hamilton's essay "On the Philosophy of [236] the Unconditioned," which I came upon, by chance, in an odd volume of the "Edinburgh Review." The latter was certainly strange reading for a boy, and I could not possibly have understood a great deal of it;[10] nevertheless, I devoured it with avidity, and it stamped upon my mind the strong conviction that, on even the most solemn and important of questions, men are apt to take cunning phrases for answers; and that the limitation of our faculties, in a great number of cases, renders real answers to such questions, not merely actually impossible, but

theoretically inconceivable.

Philosophy and history having laid hold of me in this eccentric fashion, have never loosened their grip. I have no pretension to be an expert. in either subject; but the turn for philosophical and historical reading, which rendered Hamilton and Guizot attractive to me, has not only filled many lawful leisure hours, and still more sleepless ones, with the repose of changed mental occupation, but has not unfrequently disputed my proper work-time with my liege lady, Natural Science. In this way I have found it possible to cover a good deal of ground in the territory of philosophy; and all the more easily that I have never cared much about A's [237] or B's opinion's, but have rather sought to know what answer he had to give to the questions I had to put to him–that of the limitation of possible knowledge being the chief. The ordinary examiner, with his "State the views of So-and-so," would have floored me at any time. If he had said what do you think about any given problem, I might have got on fairly well.

The reader who has had the patience to follow the enforced, but unwilling, egotism of this veritable history (especially if his studies have led him in the same direction), will now see why my mind steadily gravitated towards the conclusions of Hume and Kant, so well stated by the latter in a sentence, which I have quoted elsewhere.

"The greatest and perhaps the sole use of all philosophy of pure reason is, after all, merely negative, since it serves not as an organon for the enlargement [of knowledge], but as a discipline for its delimitation; and, instead of discovering truth, has only the modest merit of preventing error."[11]

When I reached intellectual maturity and began to ask myself whether I was an atheist, a theist, or a pantheist; a materialist or an idealist; Christian or a freethinker; I found that the more I learned and reflected, the less ready was the answer; until, at last, I came to the conclu[238]sion that I had neither art nor part with any of these denominations, except the last. The one thing in which most of these good people were agreed was the one thing in which I differed from them. They were quite sure they had attained a certain "gnosis,"–had, more or less successfully, solved the problem of existence; while I was quite sure I had not, and had a pretty strong conviction that the problem was insoluble. And, with Hume and Kant on my side, I could not think myself presumptuous in holding fast by that opinion. Like Dante,

Nel mezzo del cammin di nostra vita
Mi ritrovai per una selva oscura,

but, unlike Dante, I cannot add,

Che la diritta via era smarrita.

On the contrary, I had, and have, the firmest conviction that I never left the "verace via"–the straight road; and that this road led nowhere else but into the dark depths of a wild and tangled forest. And though I have found leopards and lions in the path; though I have made abundant acquaintance with the hungry wolf, that "with privy paw devours apace and nothing said," as another great poet says of the

ravening beast; and though no friendly spectre has even yet offered his guidance, I was, and am, minded to go straight on, until I either come out on the other side of the [239] wood, or find there is no other side to it, at least, none attainable by me.

This was my situation when I had the good fortune to find a place among the members of that remarkable confraternity of antagonists, long since deceased, but of green and pious memory, the Metaphysical Society. Every variety of philosophical and theological opinion was represented there, and expressed itself with entire openness; most of my colleagues were *-ists* of one sort or another; and, however kind and friendly they might be, I, the man without a rag of a label to cover himself with, could not fail to have some of the uneasy feelings which must have beset the historical fox when, after leaving the trap in which his tail remained, he presented himself to his normally elongated companions. So I took thought, and invented what I conceived to be the appropriate title of "agnostic." It came into my head as suggestively antithetic to the "gnostic" of Church history, who professed to know so much about the very things of which I was ignorant; and I took the earliest opportunity of parading it at our Society, to show that I, too, had a tail, like the other foxes. To my great satisfaction, the term took; and when the *Spectator* had stood godfather to it, any suspicion in the minds of respectable people, that a knowledge of its parentage might have awakened was, of course, completely lulled.

That is the history of the origin of the terms [240] "agnostic" and "agnosticism"; and it will be observed that it does not quite agree with the confident assertion of the reverend Principal of King's College, that "the adoption of the term agnostic is only an attempt to shift the issue, and that it involves a mere evasion" in relation to the Church and Christianity.[12]

The last objection (I rejoice as much as my readers must do, that it is the last) which I have to take to Dr. Wace's deliverance before the Church Congress arises, I am sorry to say, on a question of morality.

"It is, and it ought to be," authoritatively declares this official representative of Christian ethics, "an unpleasant thing for a man to have to say plainly that he does not believe in Jesus Christ" (*l.c.* p. 254).

Whether it is so depends, I imagine, a good deal on whether the man was brought up in a Christian household or not. I do not see why it should be "unpleasant" for a Mahommedan or Buddhist to say so. But that "it ought to be" unpleasant for any man to say anything which he sincerely, and after due deliberation, believes, is, to my mind, a proposition of the most profoundly immoral character. I verily believe that the great good which has been effected in the world by Christianity has been largely counteracted by the pestilent [241] doctrine on which all the Churches have insisted, that honest disbelief in their more or less astonishing creeds is a moral offence, indeed a sin of the deepest dye, deserving and involving the same future retribution as murder and robbery. If we could only see, in one view, the torrents of hypocrisy and cruelty, the lies, the slaughter, the violations of every obligation of humanity, which have flowed from this source along the course of the history of Christian nations, our worst imaginations of Hell would pale beside the vision.

A thousand times, no! It ought *not* to be unpleasant to say that which one honestly believes or

disbelieves. That it so constantly is painful to do so, is quite enough obstacle to the progress of mankind in that most valuable of all qualities, honesty of word or of deed, without erecting a sad concomitant of human weakness into something to be admired and cherished. The bravest of soldiers often, and very naturally, "feel it unpleasant" to go into action; but a court-martial which did its duty would make short work of the officer who promulgated the doctrine that his men *ought* to feel their duty unpleasant.

I am very well aware, as I suppose most thoughtful people are in these times, that the process of breaking away from old beliefs is extremely unpleasant; and I am much disposed to think that the encouragement, the consolation, and the peace afforded to earnest believers in even the [242] worst forms of Christianity are of great practical advantage to them. What deductions must be made from this gain on the score of the harm done to the citizen by the ascetic other-worldliness of logical Christianity; to the ruler, by the hatred, malice, and all uncharitableness of sectarian bigotry; to the legislator, by the spirit of exclusiveness and domination of those that count themselves pillars of orthodoxy; to the philosopher, by the restraints on the freedom of learning and teaching which every Church exercises, when it is strong enough; to the conscientious soul, by the introspective hunting after sins of the mint and cummin type, the fear of theological error, and the overpowering terror of possible damnation, which have accompanied the Churches like their shadow, I need not now consider; but they are assuredly not small. If agnostics lose heavily on the one side, they gain a good deal on the other. People who talk about the comforts of belief appear to forget its discomforts; they ignore the fact that the Christianity of the Churches is something more than faith in the ideal personality of Jesus, which they create for themselves, *plus* so much as can be carried into practice, without disorganising civil society, of the maxims of the Sermon on the Mount. Trip in morals or in doctrine (especially in doctrine), without due repentance or retractation, or fail to get properly baptized before you die, and a *plébiscite* of the Christians of Europe, if they [243] were true to their creeds, would affirm your everlasting damnation by an immense majority.

Preachers, orthodox and heterodox, din into our ears that the world cannot get on without faith of some sort. There is a sense in which that is as eminently as obviously true; there is another, in which, in my judgment, it is as eminently as obviously false, and it seems to me that the hortatory, or pulpit, mind is apt to oscillate between the false and the true meanings, without being aware of the fact.

It is quite true that the ground of every one of our actions, and the validity of all our reasonings, rest upon the great act of faith, which leads us to take the experience of the past as a safe guide in our dealings with the present and the future. From the nature of ratiocination, it is obvious that the axioms, on which it is based, cannot be demonstrated by ratiocination. It is also a trite observation that, in the business of life, we constantly take the most serious action upon evidence of an utterly insufficient character. But it is surely plain that faith is not necessarily entitled to dispense with ratiocination because ratiocination cannot dispense with faith as a starting-point; and that because we are often obliged, by the pressure of events, to act on very bad evidence, it does not follow that it is proper to act on such evidence when the pressure is absent.

The writer of the epistle to the Hebrews tells [244] us that "faith is the assurance of things hoped for, the proving of things not seen." In the authorised version, "substance" stands for "assurance," and

"evidence" for "proving." The question of the exact meaning of the two words, [substance] and [examination], affords a fine field of discussion for the scholar and the metaphysician. But I fancy we shall be not far from the mark if we take the writer to have had in his mind the profound psychological truth, that men constantly feel certain about things for which they strongly hope, but have no evidence, in the legal or logical sense of the word; and he calls this feeling "faith." I may have the most absolute faith that a friend has not committed the crime of which he is accused. In the early days of English history, if my friend could have obtained a few more compurgators of a like robust faith, he would have been acquitted. At the present day, if I tendered myself as a witness on that score, the judge would tell me to stand down, and the youngest barrister would smile at my simplicity. Miserable indeed is the man who has not such faith in some of his fellow-men–only less miserable than the man who allows himself to forget that such faith is not, strictly speaking, evidence; and when his faith is disappointed, as will happen now and again, turns Timon and blames the universe for his own blunders. And so, if a man can find a friend, the hypostasis of all his hopes, the mirror of his [245] ethical ideal, in the Jesus of any, or all, of the Gospels, let him live by faith in that ideal. Who shall or can forbid him? But let him not delude himself with the notion that his faith is evidence of the objective reality of that in which he trusts. Such evidence is to be obtained only by the use of the methods of science, as applied to history and to literature, and it amounts at present to very little.

It appears that Mr. Gladstone some time ago asked Mr. Laing if he could draw up a short summary of the negative creed; a body of negative propositions, which have so far been adopted on the negative side as to be what the Apostles' and other accepted creeds are on the positive; and Mr. Laing at once kindly obliged Mr. Gladstone with the desired articles–eight of them.

If any one had preferred this request to me, I should have replied that, if he referred to agnostics, they have no creed; and, by the nature of the case, cannot have any. Agnosticism, in fact, is not a creed, but a method, the essence of which lies in the rigorous application of a single principle. That principle is of great antiquity; it is as old as Socrates; as old as the writer who said, "Try all things, hold fast by that which is good" it is the foundation of the Reformation, which simply illustrated the axiom that every man should be able [246] to give a reason for the faith that is in him; it is the great principle of Descartes; it is the fundamental axiom of modern science. Positively the principle may be expressed: In matters of the intellect, follow your reason as far as it will take you, without regard to any other consideration. And negatively: In matters of the intellect do not pretend that conclusions are certain which are not demonstrated or demonstrable. That I take to be the agnostic faith, which if a man keep whole and undefiled, he shall not be ashamed to look the universe in the face, whatever the future may have in store for him.

The results of the working out of the agnostic principle will vary according to individual knowledge and capacity, and according to the general condition of science. That which is unproven today may be proven by the help of new discoveries to-morrow. The only negative fixed points will be those negations which flow from the demonstrable limitation of our faculties. And the only obligation accepted is to have the mind always open to conviction. Agnostics who never fail in carrying out their principles are, I am afraid, as rare as other people of whom the same consistency can be truthfully predicated. But, if you were to meet with such a phœnix and to tell him that you had discovered that two and two make five, he

would patiently ask you to state your reasons for that conviction, and express his readiness to [247] agree with you if he found them satisfactory. The apostolic injunction to "suffer fools gladly" should be the rule of life of a true agnostic. I am deeply conscious how far I myself fall short of this ideal, but it is my personal conception of what agnostics ought to be.

However, as I began by stating, I speak only for myself; and I do not dream of anathematizing and excommunicating Mr. Laing. But, when I consider his creed and compare it with the Athanasian, I think I have on the whole a clearer conception of the meaning of the latter. "Polarity," in Article VIII., for example, is a word about which I heard a good deal in my youth, when "Naturphilosophie" was in fashion, and greatly did I suffer from it. For many years past, whenever I have met with "polarity" anywhere but in a discussion of some purely physical topic, such as magnetism, I have shut the book. Mr. Laing must excuse me if the force of habit was too much for me when I read his eighth article.

And now, what is to be said to Mr. Harrison's remarkable deliverance "On the future of agnosticism"?[13] I would that it were not my business to say anything, for I am afraid I can say nothing which shall manifest my great personal respect for this able writer, and for the zeal and energy with which he ever and anon galvanises the [248] weakly frame of Positivism until it looks, more than ever, like John Bunyan's Pope and Pagan rolled into one. There is a story often repeated, and I am afraid none the less mythical on that account, of a valiant and loud-voiced corporal in command of two full privates who, falling in with a regiment of the enemy in the dark, orders it to surrender under pain of instant annihilation by his force; and the enemy surrenders accordingly. I am always reminded of this tale when I read the positivist commands to the forces of Christianity and of Science; only the enemy show no more signs of intending to obey now than they have done any time these forty years.

The allocution under consideration has a certain papal flavour. Mr. Harrison speaks with authority and not as one of the common scribes of the period. He knows not only what agnosticism is and how it has come about, but what will become of it. The agnostic is to content himself with being the precursor of the positivist. In his place, as a sort of navvy levelling the ground and cleansing it of such poor stuff as Christianity, he is a useful creature who deserves patting on the back, on condition that he does not venture beyond his last. But let not these scientific Sanballats presume that they are good enough to take part in the building of the Temple–they are mere Samaritans, doomed to die out in proportion as [249] the Religion of Humanity is accepted by mankind. Well, if that is their fate, they have time to be cheerful. But let us hear Mr. Harrison's pronouncement of their doom.

"Agnosticism is a stage in the evolution of religion, an entirely negative stage, the point reached by physicists, a purely mental conclusion, with no relation to things social at all" (p. 154). I am quite dazed by this declaration. Are there, then, any "conclusions" that are not "purely mental"? Is there "no relation to things social" in "mental conclusions" which affect men's whole conception of life? Was that prince of agnostics, David Hume, particularly imbued with physical science? Supposing physical science to be non-existent, would not the agnostic principle, applied by the philologist and the historian, lead to exactly the same results? Is the modern more or less complete suspension of judgment as to the facts of the history of regal Rome, or the real origin of the Homeric poems, anything but agnosticism in history

and in literature? And if so, how can agnosticism be the "mere negation of the physicist"?

"Agnosticism is a stage in the evolution of religion." No two people agree as to what is meant by the term "religion"; but if it means, as I think it ought to mean, simply the reverence and love for the ethical ideal, and the desire to realise that ideal in life, which every man ought [250] to feel–then I say agnosticism has no more to do with it than it has to do with music or painting. If, on the other hand, Mr. Harrison, like most people, means by "religion" theology, then, in my judgment, agnosticism can be said to be a stage in its evolution, only as death may be said to be the final stage in the evolution of life.

"When agnostic logic is simply one of the canons of thought, agnosticism, as a distinctive faith, will have spontaneously disappeared" (p. 155).

I can but marvel that such sentences as this, and those already quoted, should have proceeded from Mr. Harrison's pen. Does he really mean to suggest that agnostics have a logic peculiar to themselves? Will he kindly help me out of my bewilderment when I try to think of "logic" being anything else than the canon (which, I believe, means rule) of thought? As to agnosticism being a distinctive faith, I have already shown that it cannot possibly be anything of the kind, unless perfect faith in logic is distinctive of agnostics; which, after all, it may be.

"Agnosticism as a religious philosophy *per se* rests on an almost total ignoring of history and social evolution" (p. 152).

But neither *per se* nor *per aliud* has agnosticism (if I know anything about it) the least pretension to be a religious philosophy; so far from resting on ignorance of history, and that social evolution [251] of which history is the account, it is and has been the inevitable result of the strict adherence to scientific methods by historical investigators. Our forefathers were quite confident about the existence of Romulus and Remus, of King Arthur, and of Hengist and Horsa. Most of us have become agnostics in regard to the reality of these worthies. It is a matter of notoriety of which Mr. Harrison, who accuses us all so freely of ignoring history, should not be ignorant, that the critical process which has shattered the foundations of orthodox Christian doctrine owes its origin, not to the devotees of physical science, but, before all, to Richard Simon, the learned French Oratorian, just two hundred years ago. I cannot find evidence that either Simon, or any one of the great scholars and critics of the eighteenth and nineteenth centuries who have continued Simon's work, had any particular acquaintance with physical science. I have already pointed out that Hume was independent of it. And certainly one of the most potent influences in the same direction, upon history in the present century, that of Grote, did not come from the physical side. Physical science, in fact, has had nothing directly to do with the criticism of the Gospels; it is wholly incompetent to furnish demonstrative evidence that any statement made in these histories is untrue. Indeed, modern physiology can find parallels in nature for events of apparently [252] the most eminently supernatural kind recounted in some of those histories.

It is a comfort to hear, upon Mr. Harrison's authority, that the laws of physical nature show no signs of becoming "less definite, less consistent, or less popular as time goes on" (p. 154). How a law of nature is to become indefinite, or "inconsistent," passes my poor powers of imagination. But with universal

suffrage and the coach-dog theory of premiership in full view; the theory, I mean, that the whole duty of a political chief is to look sharp for the way the social coach is driving, and then run in front and bark loud–as if being the leading noise-maker and guiding were the same things–it is truly satisfactory to me to know that the laws of nature are increasing in popularity. Looking at recent developments of the policy which is said to express the great heart of the people, I have had my doubts of the fact; and my love for my fellow-countrymen has led me to reflect, with dread, on what will happen to them, if any of the laws of nature ever become so unpopular in their eyes, as to be voted down by the transcendent authority of universal suffrage. If the legion of demons, before they set out on their journey in the swine, had had time to hold a meeting and to resolve unanimously "That the law of gravitation is oppressive and ought to be repealed," I am afraid it would have made no sort of difference to the result, when their two [253] thousand unwilling porters were once launched down the steep slopes of the fatal shore of Gennesaret.

"The question of the place of religion as an element of human nature, as a force of human society, its origin, analysis, and functions, has never been considered at all from an agnostic point of view" (p. 152).

I doubt not that Mr. Harrison knows vastly more about history than I do; in fact, he tells the public that some of my friends and I have had no opportunity of occupying ourselves with that subject. I do not like to contradict any statement which Mr. Harrison makes on his own authority; only, if I may be true to my agnostic principles, I humbly ask how he has obtained assurance on this head. I do not profess to know anything about the range of Mr. Harrison's studies; but as he has thought it fitting to start the subject, I may venture to point out that, on evidence adduced, it might be equally permissible to draw the conclusion that Mr. Harrison's other labours have not allowed him to acquire that acquaintance with the methods and results of physical science, or with the history of philosophy, or of philological and historical criticism, which is essential to any one who desires to obtain a right understanding of agnosticism. Incompetence in philosophy, and in all branches of science except mathematics, is the well-known [254] mental characteristic of the founder of positivism. Faithfulness in disciples is an admirable quality in itself; the pity is that it not unfrequently leads to the imitation of the weaknesses as well as of the strength of the master. It is only such over-faithfulness which can account for a "strong mind really saturated with the historical sense" (p. 153) exhibiting the extraordinary forgetfulness of the historical fact of the existence of David Hume implied by the assertion that

"it would be difficult to name a single known agnostic who has given to history anything like the amount of thought and study which he brings to a knowledge of the physical world" (p. 153)

Whoso calls to mind what I may venture to term the bright side of Christianity–that ideal of manhood, with its strength and its patience, its justice and its pity for human frailty, its helpfulness to the extremity of self-sacrifice, its ethical purity and nobility, which apostles have pictured, in which armies of martyrs have placed their unshakable faith, and whence obscure men and women, like Catherine of Sienna and John Knox, have derived the courage to rebuke popes and kings–is not likely to underrate the importance of the Christian faith as a factor in human history, or to doubt that if that faith should prove to be incompatible with our knowledge, or necessary want of knowledge, some other hypostasis of men's hopes, genuine enough and worthy enough [255] to replace it, will arise. But that the incongruous

mixture of bad science with eviscerated papistry, out of which Comte manufactured the positivist religion, will be the heir of the Christian ages, I have too much respect for the humanity of the future to believe. Charles the Second told his brother, "They will not kill me, James, to make you king." And if critical science is remorselessly destroying the historical foundations of the noblest ideal of humanity which mankind have yet worshipped, it is little likely to permit the pitiful reality to climb into the vacant shrine.

That a man should determine to devote himself to the service of humanity–including intellectual and moral self-culture under that name; that this should be, in the proper sense of the word, his religion–is not only an intelligible, but, I think, a laudable resolution. And I am greatly disposed to believe that it is the only religion which will prove itself to be unassailably acceptable so long as the human race endures. But when the Comtist asks me to worship "Humanity"–that is to say, to adore the generalised conception of men as they ever have been and probably ever will be–I must reply that I could just as soon bow down and worship the generalised conception of a "wilderness of apes." Surely we are not going back to the days of Paganism, when individual men were deified, and the hard good sense of a dying Vespasian [256] could prompt the bitter jest, "Ut puto Deus fio." No divinity doth hedge a modern man, be he even a sovereign ruler. Nor is there any one, except a municipal magistrate, who is officially declared worshipful. But if there is no spark of worship-worthy divinity in the individual twigs of humanity, whence comes that godlike splendour which the Moses of Positivism fondly imagines to pervade the whole bush?

I know no study which is so unutterably saddening as that of the evolution of humanity, as it is set forth in the annals of history. Out of the darkness of prehistoric ages man emerges with the marks of his lowly origin strong upon him. He is a brute, only more intelligent than the other brutes, a blind prey to impulses, which as often as not lead him to destruction; a victim to endless illusions, which make his mental existence a terror and a burden, and fill his physical life with barren toil and battle. He attains a certain degree of physical comfort, and develops a more or less workable theory of life, in such favourable situations as the plains of Mesopotamia or of Egypt, and then, for thousands and thousands of years, struggles, with varying fortunes, attended by infinite wickedness, bloodshed, and misery, to maintain himself at this point against the greed and the ambition of his fellow-men. He makes a point of killing and otherwise persecuting all those who first try to get him to move on; and [257] when he has moved on a step, foolishly confers post-mortem deification on his victims. He exactly repeats the process with all who want to move a step yet farther. And the best men of the best epochs are simply those who make the fewest blunders and commit the fewest sins.

That one should rejoice in the good man, forgive the bad man, and pity and help all men to the best of one's ability, is surely indisputable. It is the glory of Judaism and of Christianity to have proclaimed this truth, through all their aberrations. But the worship of a God who needs forgiveness and help, and deserves pity every hour of his existence, is no better than that of any other voluntarily selected fetish. The Emperor Julian's project was hopeful in comparison with the prospects of the Comtist Anthropolatry.

When the historian of religion in the twentieth century is writing about the nineteenth, I foresee he will say something of this kind:

The most curious and instructive events in the religious history of the preceding century are the rise and progress of two new sects called Mormons and Positivists. To the student who has carefully considered these remarkable phenomena nothing in the records of religious self-delusion can appear improbable.

The Mormons arose in the midst of the great [258] Republic, which, though comparatively insignificant, at that time, in territory as in the number of its citizens, was (as we know from the fragments of the speeches of its orators which have come down to us) no less remarkable for the native intelligence of its population than for the wide extent of their information, owing to the activity of their publishers in diffusing all that they could invent, beg, borrow, or steal. Nor were they less noted for their perfect freedom from all restraints in thought, or speech, or deed; except, to be sure, the beneficent and wise influence of the majority, exerted, in case of need, through an institution known as "tarring and feathering," the exact nature of which is now disputed.

There is a complete consensus of testimony that the founder of Mormonism, one Joseph Smith, was a low-minded, ignorant scamp, and that he stole the "Scriptures" which he propounded; not being clever enough to forge even such contemptible stuff as they contain. Nevertheless he must have been a man of some force of character, for a considerable number of disciples soon gathered about him. In spite of repeated outbursts of popular hatred and violence–during one of which persecutions Smith was brutally murdered–the Mormon body steadily increased, and became a flourishing community. But the Mormon practices being objectionable to the majority, they were, more than once, without any pretence of law, but by force of riot, arson, and [259] murder, driven away from the land they had occupied. Harried by these persecutions, the Mormon body eventually committed itself to the tender mercies of a desert as barren as that of Sinai; and after terrible sufferings and privations, reached the Oasis of Utah. Here it grew and flourished, sending out missionaries to, and receiving converts from, all parts of Europe, sometimes to the number of 10,000 in a year; until, in 1880, the rich and flourishing community numbered 110,000 souls in Utah alone, while there were probably 30,000 or 40,000 scattered abroad elsewhere. In the whole history of religions there is no more remarkable example of the power of faith; and, in this case, the founder of that faith was indubitably a most despicable creature. It is interesting to observe that the course taken by the great Republic and its citizens runs exactly parallel with that taken by the Roman Empire and its citizens towards the early Christians, except that the Romans had a certain legal excuse for their acts of violence, inasmuch as the Christian "sodalitia" were not licensed, and consequently were, *ipso facto,* illegal assemblages. Until, in the latter part of the nineteenth century, the United States legislature decreed the illegality of polygamy, the Mormons were wholly within the law.

Nothing can present a greater contrast to all this than the history of the Positivists. This sect arose much about the same time as that of the [260] Mormons, in the upper and most instructed stratum of the quick-witted, sceptical population of Paris. The founder, Auguste Comte, was a teacher of mathematics, but of no eminence in that department of knowledge, and with nothing but an amateur's acquaintance with physical, chemical, and biological science. His works are repulsive, on account of the dull diffuseness of their style, and a certain air, as of a superior person, which characterises them; but nevertheless they contain good things here and there. It would take too much space to reproduce in detail a system which proposes to regulate all human life by the promulgation of a Gentile Leviticus. Suffice it to say, that M.

Comte may be described as a syncretic, who, like the Gnostics of early Church history, attempted to combine the substance of imperfectly comprehended contemporary science with the form of Roman Christianity. It may be that this is the reason why his disciples were so very angry with some obscure people called Agnostics, whose views, if we may judge by the account left in the works of a great Positivist controversial writer, were very absurd.

To put the matter briefly, M. Comte, finding Christianity and Science at daggers drawn, seems to have said to Science, "You find Christianity rotten at the core, do you? Well, I will scoop out the inside of it." And to Romanism: "You find Science mere dry light–cold and bare. [261] Well, I will put your shell over it, and so, as schoolboys make a spectre out of a turnip and a tallow candle, behold the new religion of Humanity complete!"

Unfortunately neither the Romanists, nor the people who were something more than amateurs in science, could be got to worship M. Comte's new idol properly. In the native country of Positivism, one distinguished man of letters and one of science, for a time, helped to make up a roomful of the faithful, but their love soon grew cold. In England, on the other hand, there appears to be little doubt that, in the ninth decade of the century, the multitude of disciples reached the grand total of several score. They had the advantage of the advocacy of one or two most eloquent and learned apostles, and, at any rate, the sympathy of several persons of light and leading; and, if they were not seen, they were heard, all over the world. On the other hand, as a sect, they laboured under the prodigious disadvantage of being refined, estimable people, living in the midst of the worn-out civilisation of the old world; where any one who had tried to persecute them, as the Mormons were persecuted, would have been instantly hanged. But the majority never dreamed of persecuting them; on the contrary, they were rather given to scold and otherwise try the patience of the majority.

The history of these sects in the closing years [262] of the century is highly instructive. Mormonism . . . .

But I find I have suddenly slipped off Mr. Harrison's tripod, which I had borrowed for the occasion. The fact is, I am not equal to the prophetical business, and ought not to have undertaken it.

[It did not occur to me, while writing the latter part of this essay, that it could be needful to disclaim the intention of putting the religious system of Comte on a level with Mormonism. And I was unaware of the fact that Mr. Harrison rejects the greater part of the Positivist Religion, as taught by Comte. I have, therefore, erased one or two passages, which implied his adherence to the "Religion of Humanity" as developed by Comte, 1893.]

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[1] See the *Official Report of the Church Congress held at Manchester*, October 1888, pp. 253, 254.

[2] [In this place and in the eleventh essay, there are references to the late Archbishop of York which are of no importance to my main argument, and which I have expunged because I desire to obliterate the traces of a

temporary misunderstanding with a man of rare ability, candour, and wit, for whom I entertained a great liking and no less respect. I rejoice to think now of the (then) Bishop's cordial hail the first time we met after our little skirmish, "Well, is it to be peace or war?" I replied, "A little of both." But there was only peace when we parted, and ever after.

[3] Dr. Wace tells us, "It may be asked how far we can rely on the accounts we possess of our Lord's teachings on these subjects." And he seems to think the question appropriately answered by the assertion that it "ought to be regarded as settled by M. Renan's practical surrender of the adverse case." I thought I knew M. Renan's works pretty well, but I have contrived to miss this "practical" (I wish Dr. Wace had defined the scope of that useful adjective) surrender. However, as Dr. Wace can find no difficulty in pointing out the passage of M. Renan's writings, by which he feels justified in making his statement, I shall wait for further enlightenment, contenting myself, for the present, with remarking that if M. Renan were to retract and do penance in Notre Dame to-morrow for any contributions to Biblical criticism that may be specially his property, the main results of that criticism, as they are set forth in the works of Strauss, Baur, Reuss, and Volkmar, for example, would not be sensibly affected.

[4] [See De Gobineau, *La Religions et les Philosophies dans l'Asie Centrale;* and the recently published work of Mr. E. G. Browne, *The Episode of the Bab.*]

[5] Here, as always the revised version is cited.

[6] Does any one really mean to say that there is any internal or external criterion by which the reader of a biblical statement, in which scientific matter is contained, is enabled to judge whether it is to be taken *au sérieux* or not? Is the account of the Deluge, accepted as true in the New Testament, less precise and specific than that of the call of Abraham, also accepted as true therein? By what mark does the story of the feedings with manna in the wilderness, which involves some very curious scientific problems, show that it is meant merely for edification, while the story of the inscription of the Law on stone by the hand of Jahveh is literally true? If the story of the Fall is not the true record of an historical occurrence, what becomes of Pauline theology? Yet the story of the Fall as directly conflicts with probability, and is as devoid of trustworthy evidence as that of the Creation or that of the Deluge, with which it forms an harmoniously legendary series.

[7] See, for an admirable discussion of the whole subject, Dr. Abbott's article on the Gospels in the *Encyclopædia Britannica;* and the remarkable monograph by Professor Volkmar, *Jesus Nazarenus und die erste christliche Zeit* (1882). Whether we agree with the conclusions of these writers or not, the method of critical investigation which they adopt is unimpeachable.

[8] Notwithstanding the hard words shot at me from behind the hedge of anonymity by a writer in a recent number of the *Quarterly Review*, I repeat, without the slightest fear of refutation, that the four Gospels, as they have come to us, are the work of unknown writers.

[9] Their arguments, in the long run, are always reducible to one form. Otherwise trustworthy witnesses affirm that such and such events took place. These events are inexplicable, except the agency of "spirits" is admitted. Therefore "spirits" were the cause of the phenomena. And the heads of the reply are always the same. Remember Goethe's aphorism: "Alles factische ist schon Theorie." Trustworthy witnesses are constantly deceived, or deceive themselves, in their interpretation of sensible phenomena. No one can prove that the sensible phenomena,

in these cases, could be caused only by the agency of spirits: and there is abundant ground for believing that they may be produced in other ways. Therefore, the utmost that can be reasonably asked for, on the evidence as it stands, is suspension of judgment. And, on the necessity for even that suspension, reasonable men may differ, according to their views of probability.

[10] Yet I must somehow have laid hold of the pith of the matter, for, many years afterwards, when Dean Mansel's Bampton Lectures were published, it seemed to me I already knew all that this eminently agnostic thinker had to tell me.

[11] *Kritik der reinen Vernunft.* Edit. Hartenstein, p. 256.

[12] *Report of the Church Congress,* Manchester, 1888, p. 252.

[13] *Fortnightly Review,* Jan. 1889.

THE HUXLEY FILE

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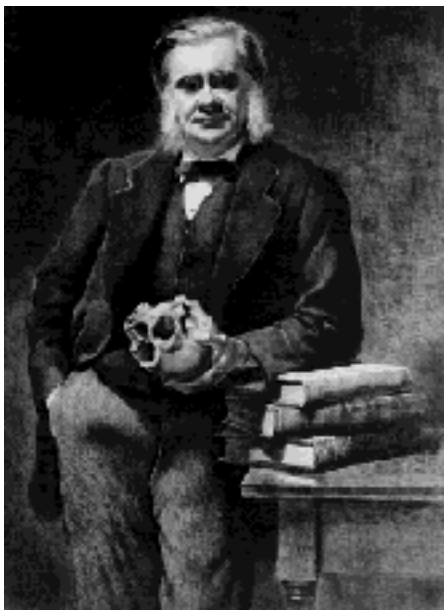

Agnosticism: A Rejoinder (1889)

Collected Essays V

[263] Those who passed from Dr. Wace's article in the last number of the "Nineteenth Century" to the anticipatory confutation of it which followed in "The New Reformation," must have enjoyed the pleasure of a dramatic surprise–just as when the fifth act of a new play proves unexpectedly bright and interesting. Mrs. Ward will, I hope, pardon the comparison, if I say that her effective clearing away of antiquated incumbrances from the lists of the controversy, reminds me of nothing so much as of the action of some neat-handed, but strong-wristed, Phyllis, who, gracefully wielding her long-handled "Turk's head," sweeps away the accumulated results of the toil of generations of spiders. I am the more indebted to this luminous sketch of the results of critical investigation, as it is carried out among those theologians who are men of science and not mere counsel for creeds, [264] since it has relieved me from the necessity of dealing with the greater part of Dr. Wace's polemic, and enables me to devote more space to the really important issues which have been raised.[1]

Perhaps, however, it may be well for me to observe that approbation of the manner in which a great biblical scholar, for instance, Reuss, does his work does not commit me to the adoption of all, or indeed any of his views; and, further, that the disagreements of a series of investigators do not in any way interfere with the fact that each of them has made important contributions to the body of truth ultimately established. If I cite Buffon, Linnæus, Lamarck, and Cuvier, as having each and all taken a leading share in building up modern biology, the statement that every one of these great naturalists disagreed with, and even more or less contradicted, all the rest is quite true; but the supposition that the latter assertion is in any way inconsistent with the former, would betray a strange ignorance of the manner in which all true science advances.

Dr. Wace takes a great deal of trouble to make it appear that I have desired to evade the real questions raised by his attack upon me at the [265] Church Congress. I assure the reverend Principal that in this, as in some other respects, he has entertained a very erroneous conception of my intentions. Things would assume more accurate proportions in Dr. Wace's mind, if he would kindly remember that it is just thirty years since ecclesiastical thunderbolts began to fly about my ears. I have had the "Lion and the Bear" to deal with, and it is long since I got quite used to the threatenings of episcopal Goliaths, whose croziers were like unto a weaver's beam. So that I almost think I might not have noticed Dr. Wace's attack, personal as it was; and although, as he is good enough to tell us, separate copies are to be had for the modest equivalent of twopence, as a matter of fact, it did not come under my notice for a long time after it was made. May I further venture to point out that (reckoning postage) the expenditure of twopence-halfpenny, or, at the most, threepence, would have enabled Dr. Wace so far to comply with ordinary conventions; as to direct my attention to the fact that he had attacked me before a meeting at which I was not present? I really am not responsible for the five months' neglect of which Dr. Wace complains. Singularly enough, the Englishry who swarmed about the Engadine, during the three months that I was being brought back to life by the glorious air and perfect comfort of the Maloja, did not, in my hearing,

say anything about the [266] important events which had taken place at the Church Congress; and I think I can venture to affirm that there was not a single copy of Dr. Wace's pamphlet in any of the hotel libraries which I rummaged, in search of something more edifying than dull English or questionable French novels.

And now, having, as I hope, set myself right with the public as regards the sins of commission and omission with which I have been charged, I feel free to deal with matters to which time and type may be more profitably devoted.

I believe that there is not a solitary argument I have used, or that I am about to use, which is original, or has anything to do with the fact that I have been chiefly occupied with natural science. They are all, facts and reasoning alike, either identical with, or consequential upon, propositions which are to be found in the works of scholars and theologians of the highest repute in the only two countries, Holland and Germany,[2] in which, at the present time, professors of theology are to be found, whose tenure of their posts does not depend upon the results to which their inquiries lead them.[3] It is true that, to the best of my [267] ability, I have satisfied myself of the soundness of the foundations on which my arguments are built, and I desire to be held fully responsible for everything I say. But, nevertheless, my position is really no more than that of an expositor; and my justification for undertaking it is simply that conviction of the supremacy of private judgment (indeed, of the impossibility of escaping it) which is the foundation of the Protestant Reformation, and which was the doctrine accepted by the vast majority of the Anglicans of my youth, before that backsliding towards the "beggarly rudiments" of an effete and idolatrous sacerdotalism which has, even now, provided us with the saddest spectacle which has been offered to the eyes of Englishmen in this generation. A high court of ecclesiastical jurisdiction, with a host of great lawyers in battle array, is and, for Heaven knows how long, will be, occupied with these very questions of "washing of cups and pots and brazen vessels," which the Master, whose professed [268] representatives are rending the Church over these squabbles, had in his mind when, as we are told, he uttered the scathing rebuke:–

> "Well did Isaiah prophesy of you hypocrites, as it is written,
> This people honoureth me with their lips,
> But their heart is far from me
> But in vain do they worship me,
> Teaching as their doctrines the precepts of men."
>
> (Mark vii. 6-7.)

Men who can be absorbed in bickerings over miserable disputes of this kind can have but little sympathy with the old evangelical doctrine of the "open Bible," or anything but a grave misgiving of the results of diligent reading of the Bible, without the help of ecclesiastical spectacles by the mass of the people. Greatly to the surprise of many of my friends, I have always advocated the reading of the Bible, and the diffusion of the study of that most remarkable collection of books among the people. Its teachings are so infinitely superior to those of the sects, who are just as busy now as the Pharisees were eighteen hundred

years ago, in smothering them under "the precepts of men"; it is so certain, to my mind, that the Bible contains within itself the refutation of nine-tenths of the mixture of sophistical metaphysics and old-world superstition which has been piled round it by the so-called Christians of later times; it is so clear that the only immediate and ready antidote to the poison which has been mixed with [269] Christianity, to the intoxication and delusion of mankind, lies in copious draughts from the undefiled spring, that I exercise the right and duty of free judgment on the part of every man, mainly for the purpose of inducing other laymen to follow my example. If the New Testament is translated into Zulu by Protestant missionaries, it must be assumed that a Zulu convert is competent to draw from its contents all the truths which it is necessary for him to believe. I trust that I may, without immodesty, claim to be put on the same footing as a Zulu.

The most constant reproach which is launched against persons of my way of thinking is that it is all very well for us to talk about the deductions of scientific thought, but what are the poor and the uneducated to do? Has it ever occurred to those who talk in this fashion, that their creeds and the articles of their several confessions, their determination of the exact nature and extent of the teachings of Jesus, their expositions of the real meaning of that which is written in the Epistles (to leave aside all questions concerning the Old Testament), are nothing more than deductions which, at any rate, profess to be the result of strictly scientific thinking, and which are not worth attending to unless they really possess that character? If it is not historically true that such and such things happened in Palestine eighteen centuries ago, what becomes of Chris[270]tianity? And what is historical truth but that of which the evidence bears strict scientific investigation? I do not call to mind any problem of natural science which has come under my notice which is more difficult, or more curiously interesting as a mere problem, than that of the origin of the Synoptic Gospels and that of the historical value of the narratives which they contain. The Christianity of the Churches stands or falls by the results of the purely scientific investigation of these questions. They were first taken up, in a purely scientific spirit, about a century ago; they have been studied over and over again by men of vast knowledge and critical acumen; but he would be a rash man who should assert that any solution of these problems, as yet formulated, is exhaustive. The most that can be said is that certain prevalent solutions are certainly false, while others are more or less probably true.

If I am doing my best to rouse my countrymen out of their dogmatic slumbers, it is not that they may be amused by seeing who gets the best of it in a contest between a "scientist" and a theologian. The serious question is whether theological men of science, or theological special pleaders, are to have the confidence of the general public; it is the question whether a country in which it is possible for a body of excellent clerical and lay gentlemen to discuss, in public meeting assembled, [271] how much it is desirable to let the congregations of the faithful know of the results of biblical criticism, is likely to wake up with anything short of the grasp of a rough lay hand upon its shoulder; it is the question whether the New Testament books, being, as I believe they were, written and compiled by people who, according to their lights, were perfectly sincere, will not, when properly studied as ordinary historical documents, afford us the means of self-criticism. And it must be remembered that the New Testament books are not responsible for the doctrine invented by the Churches that they are anything but ordinary historical documents. The author of the third gospel tells us, as straightforwardly as a man can, that he has no claim to any other character than that of an ordinary compiler and editor, who had before him the works

of many and variously qualified predecessors.

In my former papers, according to Dr. Wace, I have evaded giving an answer to his main proposition, which he states as follows–

"Apart from all disputed points of criticism, no one practically doubts that our Lord lived, and that He died on the cross, in the most intensive sense of filial relation to His Father in Heaven, and that He bore testimony to that Father's providence, love, and grace towards mankind. The Lord's Prayer affords a sufficient evidence on these points. If the Sermon on the Mount alone be added, the whole unseen world, of which the Agnostic refuses to know anything, stands unveiled before us.... If [272] Jesus Christ preached that sermon, made those promises, and taught that prayer, then any one who says that we know nothing of God, or of a future life, or of an unseen world, says that he does not believe Jesus Christ" (pp. 354-355).

Again–

"The main question at issue, in a word, is one which Professor Huxley has chosen to leave entirely on one side–whether, namely, allowing for the utmost uncertainty on other points of the criticism to which he appeals, there is any reasonable doubt that the Lord's Prayer and the sermon on the Mount afford a true account of our Lord's essential belief and cardinal teaching" (p. 355).

I certainly was not aware that I had evaded the questions here stated; indeed I should say that I have indicated my reply to them pretty clearly; but, as Dr. Wace wants a plainer answer, he shall certainly be gratified. If, as Dr. Wace declares it is, his "whole case is involved in" the argument as stated in the latter of these two extracts, so much the worse for his whole case. For I am of opinion that there is the gravest reason for doubting whether the "Sermon on the Mount" was ever preached, and whether the so-called "Lord's Prayer" was ever prayed, by Jesus of Nazareth. My reasons for this opinion are, among others, these:–There is now no doubt that the three Synoptic Gospels, so far from being the work of three independent writers, are closely interdependent,[4] and that in one of two ways. Either [273] all three contain, as their foundation, versions, to a large extent verbally identical, of one and the same tradition; or two of them are thus closely dependent on the third; and the opinion of the majority of the best critics has of late years more and more converged towards the conviction that our canonical second gospel (the so-called "Mark's" Gospel) is that which most closely represents the primitive groundwork of the three.[5] That I take to be one of the most valuable results of New Testament criticism, of immeasurably greater importance than the discussion about dates and authorship.

But if, as I believe to be the case, beyond any rational doubt or dispute, the second gospel is the nearest extant representative of the oldest tradition, whether written or oral, how comes it that it contains neither the "Sermon on the Mount" nor the "Lord's Prayer," those typical embodiments, according to Dr. Wace, of the "essential belief and cardinal teaching" of Jesus? Not only does "Mark's" gospel fail to contain the "Sermon on the Mount," or anything but a very few of the sayings contained in that collection; but, at the point of the history of Jesus where the "Sermon" occurs in "Matthew," there is in "Mark" an apparently unbroken narrative from the calling of James and John to the healing of Simon's wife's mother. Thus the oldest tradition not only ignores the "Sermon on the Mount," but, by implication, raises

a probability against its being delivered when and where the later "Matthew" inserts it in his compilation.

And still more weighty is the fact that the third gospel, the author of which tells us that he wrote after "many" others had "taken in hand" the same enterprise; who should therefore have known the first gospel (if it existed), and was bound to pay to it the deference due to the work of an apostolic eye-witness (if he had any reason for thinking it was so)–this writer, who exhibits far more literary competence than the other two, ignores any "Sermon on the Mount," such as that reported by "Matthew," just as much as the oldest authority does. Yet "Luke" has a great many passages identical, or parallel, with those in "Matthew's" "Sermon on the Mount," which are, [275] for the most part, scattered about in a totally different connection.

Interposed, however, between the nomination of the Apostles and a visit to Capernaum; occupying, therefore, a place which answers to that of the "Sermon on the Mount," in the first gospel, there is, in the third gospel a discourse which is as closely similar to the "Sermon in the Mount," in some particulars, as it is widely unlike it in others.

This discourse is said to have been delivered in a "plain" or "level place" (Luke vi. 17), and by way of distinction we may call it the "Sermon on the Plain."

I see no reason to doubt that the two Evangelists are dealing, to a considerable extent, with the same traditional material; and a comparison of the two "Sermons" suggests very strongly that "Luke's" version is the earlier. The correspondences between the two forbid the notion that they are independent. They both begin with a series of blessings, some of which are almost verbally identical. In the middle of each (Luke vi. 27-38, Matt. v. 43-48) there is a striking exposition of the ethical spirit of the command given in Leviticus xix. 18. And each ends with a passage containing the declaration that a tree is to be known by its fruit, and the parable of the house built on the sand. But while there are only 29 verses in the "Sermon on the Plain" there are 107 in the "Sermon on the Mount"; the excess in length of the latter being chiefly due to the [276] long interpolations, one of 30 verses before and one of 34 verses after, the middlemost parallelism with Luke. Under these circumstances it is quite impossible to admit that there is more probability that "Matthew's" version of the Sermon is historically accurate, than there is that Luke's version is so; and they cannot both be accurate.

"Luke" either knew the collection of loosely-connected and aphoristic utterances which appear under the name of the "Sermon on the Mount" in "Matthew"; or he did not. If he did not, he must have been ignorant of the existence of such a document as our canonical "Matthew," a fact which does not make for the genuineness, or the authority, of that book. If he did, he has shown that he does not care for its authority on a matter of fact of no small importance; and that does not permit us to conceive that he believed the first gospel to be the work of an authority to whom he ought to defer, let alone that of an apostolic eyewitness.

The tradition of the Church about the second gospel, which I believe to be quite worthless, but which is all the evidence there is for "Mark's" authorship, would have us believe that "Mark" was little more than

the mouthpiece of the apostle Peter. Consequently, we are to suppose that Peter either did not know, or did not care very much for, that account of the "essential belief and cardinal teaching" of Jesus which is contained in the Sermon on the Mount; and, certainly, [277] he could not have shared Dr. Wace's view of its importance.[6]

I thought that all fairly attentive and intelligent students of the gospels, to say nothing of theologians of reputation, knew these things. But how can any one who does know them have the conscience to ask whether there is "any reasonable doubt" that the Sermon on the Mount was preached by Jesus of Nazareth? If conjecture is permissible, where nothing else is possible, the most probable conjecture seems to be that "Matthew," having a *cento* of sayings attributed–rightly or wrongly it is impossible to say–to Jesus among his materials, thought they were, or might be, records of a continuous discourse, and put them in at the place he thought likeliest. Ancient historians of the highest character saw no harm in composing long speeches which never were spoken, and putting them into the mouths of statesmen and warriors; and I presume that whoever is represented by "Matthew" would have been grievously astonished to find that any one objected to his following the example of the best models accessible to him.

[278] So with the "Lord's Prayer." Absent in our representative of the oldest tradition, it appears in both "Matthew" and "Luke." There is reason to believe that every pious Jew, at the commencement of our era, prayed three times a day, according to a formula which is embodied in the present "Schmone-Esre"[7] of the Jewish prayerbook. Jesus, who was assuredly, in all respects, a pious Jew, whatever else he may have been, doubtless did the same. Whether he modified the current formula, or whether the so-called "Lord's Prayer" is the prayer substituted for the "Schmone-Esre" in the congregations of the Gentiles, is a question which can hardly be answered.

In a subsequent passage of Dr. Wace's article (p. 356) he adds to the list of the verities which he imagines to be unassailable, "The Story of the Passion." I am not quite sure what he means by this. I am not aware that any one (with the exception of certain ancient heretics) has propounded doubts as to the reality of the crucifixion; and certainly I have no inclination to argue about the precise accuracy of every detail of that pathetic story of suffering and wrong. But, if Dr. Wace means, as I suppose he does, that that which, according to the orthodox view, happened after the crucifixion, and which is, in a dogmatic sense, the most important part of the story, is [279] founded on solid historical proofs, I must beg leave to express a diametrically opposite conviction.

What do we find when the accounts of the events in question, contained in the three Synoptic gospels, are compared together? In the oldest, there is a simple, straightforward statement which, for anything that I have to urge to the contrary, may be exactly true. In the other two, there is, round this possible and probable nucleus, a mass of accretions of the most questionable character.

The cruelty of death by crucifixion depended very much upon its lingering character. If there were a support for the weight of the body, as not unfrequently was the practice, the pain during the first hours of the infliction was not, necessarily, extreme; nor need any serious physical symptoms, at once, arise from

the wounds made by the nails in the hands and feet, supposing they were nailed, which was not invariably the case. When exhaustion set in, and hunger, thirst; and nervous irritation had done their work, the agony of the sufferer must have been terrible; and the more terrible that, in the absence of any effectual disturbance of the machinery of physical life, it might be prolonged for many hours, or even days. Temperate, strong men, such as were the ordinary Galilean peasants, might live for several days on the cross. It is necessary to bear these facts in mind when we read the account contained in the fifteenth chapter of the second gospel.

[280] Jesus was crucified at the third hour (xv. 25), and the narrative seems to imply that he died immediately after the ninth hour (v. 34). In this case, he would have been crucified only six hours; and the time spent on the cross cannot have been much longer, because Joseph of Arimathæa must have gone to Pilate, made his preparations, and deposited the body in the rock-cut tomb before sunset, which, at that time of the year, was about the twelfth hour. That any one should die after only six hours' crucifixion could not have been at all in accordance with Pilate's large experience of the effects of that method of punishment. It, therefore, quite agrees with what might be expected, that Pilate "marvelled if he were already dead" and required to be satisfied on this point by the testimony of the Roman officer who was in command of the execution party. Those who have paid attention to the extraordinarily difficult question, What are the indisputable signs of death?–will be able to estimate the value of the opinion of a rough soldier on such a subject; even if his report to the Procurator were in no wise affected by the fact that the friend of Jesus, who anxiously awaited his answer, was a man of influence and of wealth.

The inanimate body, wrapped in linen, was deposited in a spacious,[8] cool rock chamber, the [281] entrance of which was closed, not by a well-fitting door, but by a stone rolled against the opening, which would of course allow free passage of air. A little more than thirty-six hours afterwards (Friday 6 P.M., to Sunday 6 A.M., or a little after) three women visit the tomb and find it empty. And they are told by a young man "arrayed in a white robe" that Jesus is gone to his native country of Galilee, and that the disciples and Peter will find him there.

Thus it stands, plainly recorded, in the oldest tradition that, for any evidence to the contrary, the sepulchre may have been emptied at any time during the Friday or Saturday nights. If it is said that no Jew would have violated the Sabbath by taking the former course, it is to be recollected that Joseph of Arimathæa might well be familiar with that wise and liberal interpretation of the fourth commandment, which permitted works of mercy to men–nay, even the drawing of an ox or an ass out of a pit–on the Sabbath. At any rate, the Saturday night was free to the most scrupulous of observers of the Law.

These are the facts of the case as stated by the oldest extant narrative of them. I do not see why any one should have a word to say against the inherent probability of that narrative; and, for my part, I am quite ready to accept it as an historical fact, that so much and no more is positively known of the end of Jesus of Nazareth. On what [282] grounds can a reasonable man be asked to believe any more? So far as the narrative in the first gospel, on the one hand, and those in the third gospel and the Acts, on the other, go beyond what is stated in the second gospel, they are hopelessly discrepant with one another. And this is

the more significant because the pregnant phrase "some doubted," in the first gospel, is ignored in the third.

But it is said that we have the witness Paul speaking to us directly in the Epistles. There is little doubt that we have, and a very singular witness he is. According to his own showing, Paul, in the vigour of his manhood, with every means of becoming acquainted, at first hand, with the evidence of eye-witnesses, not merely refused to credit them, but "persecuted the church of God and made havoc of it." The reasoning of Stephen fell dead upon the acute intellect of this zealot for the traditions of his fathers: his eyes were blind to the ecstatic illumination of the martyr's countenance "as it had been the face of an angel;" and when, at the words "Behold, I see the heavens opened and the Son of Man standing on the right hand of God," the murderous mob rushed upon and stoned the rapt disciple of Jesus, Paul ostentatiously made himself their official accomplice.

Yet this strange man, because he has a vision one day, at once, and with equally headlong zeal, [283] flies to the opposite pole of opinion. And he is most careful to tell us that he abstained from any re-examination of the facts.

"Immediately I conferred not with flesh and blood, neither went I up to Jerusalem to them which were Apostles before me; but I went away into Arabia." (Galatians i. 16, 17.)

I do not presume to quarrel with Paul's procedure. If it satisfied him, that was his affair; and, if it satisfies anyone else, I am not called upon to dispute the right of that person to be satisfied. But I certainly have the right to say that it would not satisfy me, in like case; that I should be very much ashamed to pretend that it could, or ought to, satisfy me; and that I can entertain but a very low estimate of the value of the evidence of people who are to be satisfied in this fashion, when questions of objective fact, in which their faith is interested, are concerned. So that when I am called upon to believe a great deal more than the oldest gospel tells me about the final events of the history of Jesus on the authority of Paul (1 Corinthians xv. 5-8) I must pause. Did he think it, at any subsequent time, worth while "to confer with flesh and blood," or, in modern phrase, to re-examine the facts for himself? or was he ready to accept anything that fitted in with his preconceived ideas? Does he mean, when he speaks of all the appearances of Jesus after the crucifixion as if they were of the same kind, that [284] they were all visions, like the manifestation to himself? And, finally, how is this account to be reconciled with those in the first and third gospels–which, as we have seen, disagree with one another?

Until these questions are satisfactorily answered, I am afraid that, so far as I am concerned, Paul's testimony cannot be seriously regarded, except as it may afford evidence of the state of traditional opinion at the time at which he wrote, say between 55 and 60 A.D.; that is, more than twenty years after the event; a period much more than sufficient for the development of any amount of mythology about matters of which nothing was really known. A few years later, among the contemporaries and neighbours of the Jews, and, if the most probable interpretation of the Apocalypse can be trusted, among the followers of Jesus also, it was fully believed, in spite of all the evidence to the contrary, that the Emperor Nero was not really dead, but that he was hidden away somewhere in the East, and would

speedily come again at the head of a great army, to be revenged upon his enemies.[9]

Thus, I conceive that I have shown cause for the opinion that Dr. Wace's challenge touching the Sermon on the Mount, the Lord's Prayer, and [285] the Passion was more valorous than discreet. After all this discussion, I am still at the agnostic point. Tell me, first, what Jesus can be proved to have been, said, and done, and I will say whether I believe him, or in him,[10] or not. As Dr. Wace admits that I have dissipated his lingering shade of unbelief about the bedevilment of the Gadarene pigs, he might have done something to help mine. Instead of that, he manifests a total want of conception of the nature of the obstacles which impede the conversion of his "infidels."

The truth I believe to be, that the difficulties in the way of arriving at a sure conclusion as to these matters, from the Sermon on the Mount, the Lord's Prayer, or any other data offered by the Synoptic gospels (and *a fortiori* from the fourth gospel), are insuperable. Every one of these records is coloured by the prepossessions of those among whom the primitive traditions arose, and of those by whom they were collected and edited: and the difficulty of making allowance for these prepossessions is enhanced by our ignorance of the exact dates at which the documents were first put together; of the extent to which they [286] have been subsequently worked over and interpolated; and of the historical sense, or want of sense, and the dogmatic tendencies of their compilers and editors. Let us see if there is any other road which will take us into something better than negation.

There is a widespread notion that the "primitive Church," while under the guidance of the Apostles and their immediate successors, was a sort of dogmatic dovecot, pervaded by the most loving unity and doctrinal harmony. Protestants, especially, are fond of attributing to themselves the merit of being nearer "the Church of the Apostles" than their neighbours; and they are the less to be excused for their strange delusion because they are great readers of the documents which prove the exact contrary. The fact is that, in the course of the first three centuries of its existence, the Church rapidly underwent a process of evolution of the most remarkable character, the final stage of which is far more different from the first than Anglicanism is from Quakerism. The key to the comprehension of the problem of the origin of that which is now called "Christianity," and its relation to Jesus of Nazareth, lies here. Nor can we arrive at any sound conclusion as to what it is probable that Jesus actually said and did, without being clear on this head. By far the most important and subsequently influential steps in the evolution of [287] Christianity took place in the course of the century, more or less, which followed upon the crucifixion. It is almost the darkest period of Church history, but, most fortunately, the beginning and the end of the period are brightly illuminated by the contemporary evidence of two writers of whose historical existence there is no doubt,[11] and against the genuineness of whose most important works there is no widely-admitted objection. These are Justin, the philosopher and martyr, and Paul, the Apostle to the Gentiles. I shall call upon these witnesses only to testify to the condition of opinion among those who called themselves disciples of Jesus in their time.

Justin, in his Dialogue with Trypho the Jew, which was written somewhere about the middle of the second century, enumerates certain categories of persons who, in his opinion, will, or will not, be

saved.[12] These are:–

1. Orthodox Jews who refuse to believe that Jesus is the Christ. *Not Saved.*

2. Jews who observe the Law; believe Jesus to be the Christ; but who insist on the observance of the Law by Gentile converts. *Not Saved.*

3. Jews who observe the Law; believe Jesus to [288] be the Christ, and hold that Gentile converts need not observe the Law. *Saved* (in Justin's opinion; but some of his fellow-Christians think the contrary).

4. Gentile converts to the belief in Jesus as the Christ, who observe the Law. *Saved* (possibly).

5. Gentile believers in Jesus as the Christ, who do not observe the Law themselves (except so far as the refusal of idol sacrifices), but do not consider those who do observe it heretics. *Saved* (this is Justin's own view).

6. Gentile believers who do not observe the Law, except in refusing idol sacrifices, and hold those who do observe it to be heretics. *Saved.*

7. Gentiles who believe Jesus to be the Christ and call themselves Christians, but who eat meats sacrificed to idols. *Not Saved.*

8. Gentiles who disbelieve in Jesus as the Christ. *Not Saved.*

Justin does not consider Christians who believe in the natural birth of Jesus, of whom he implies that there is a respectable minority, to be heretics, though he himself strongly holds the preternatural birth of Jesus and his pre-existence as the "Logos" or "Word." He conceives the Logos to be a second and, inferior to the first, unknowable God, with respect to whom Justin, like Philo, is a complete agnostic. The Holy Spirit is not regarded by Justin as a separate personality, and is often mixed up with the "Logos." The [289] doctrine of the natural immortality of the soul is, for Justin, a heresy; and he is as firm a believer in the resurrection of the body, as in the speedy Second Coming and the establishment of the millennium.

This pillar of the Church in the middle of the second century–a much-travelled native of Samaria–was certainly well acquainted with Rome, probably with Alexandria; and it is likely that he knew the state of opinion throughout the length and breadth of the Christian world as well as any man of his time. If the various categories above enumerated are arranged in a series thus:–

Orthodox Judaism	Judæo-Christianity					Idolothytic Christianity	Paganism
I.	II.	III.	IV.	V.	VI.	VII.	VIII.

it is obvious that they form a gradational series from orthodox Judaism, on the extreme left, to Paganism, whether philosophic or popular, on the extreme right; and it will further be observed that, while Justin's conception of Christianity is very broad, he rigorously excludes two classes of persons who, in his time, called themselves Christians; namely, those who insist on circumcision and other observances of the Law on the part of Gentile converts; that is to say, the strict Judaeo-Christians (II.); and, on the other hand, those who assert the lawfulness of eating meat [290] offered to idols–whether they are Gnostic or not (VII.) These last I have called "idolothytic" Christians, because I cannot devise a better name, not because it is strictly defensible etymologically.

At the present moment, I do not suppose there is an English missionary in any heathen land who would trouble himself whether the materials of his dinner had been previously offered to idols or not. On the other hand, I suppose there is no Protestant sect within the pale of orthodoxy, to say nothing of the Roman and Greek Churches, which would hesitate to declare the practice of circumcision and the observance of the Jewish Sabbath and dietary rules, shockingly heretical.

Modern Christianity has, in fact, not only shifted far to the right of Justin's position, but it is of much narrower compass.

		Justin					
Judaism	Judæo-Christianity				Modern Christianity		Paganism
I.	II.	III.	IV.	V.	VI.	VII.	VIII.

For, though it includes VII, and even, in saint and relic worship, cuts a "monstrous cantle" out of paganism, it excludes, not only all Judæo-Christians, but all who doubt that such are heretics. Ever since the thirteenth century, the Inquisition would have cheerfully burned, and in Spain did abundantly burn, all persons who came under the categories II., III., IV., V. And the [291] wolf would play the same havoc now, if it could only get its blood-stained jaws free from the muzzle imposed by the secular arm.

Further, there is not a Protestant body except the Unitarian, which would not declare Justin himself a heretic, on account of his doctrine of the inferior godship of the Logos; while I am very much afraid that, in strict logic, Dr. Wace would be under the necessity, so painful to him, of calling him an "infidel," on the same and on other grounds.

Now let us turn to our other authority. If there is any result of critical investigations of the sources of

Christianity which is certain,[13] it is that Paul of Tarsus wrote the Epistle to the Galatians somewhere between the years 55 and 60 A.D., that is to say, roughly, twenty, or five-and-twenty years after the crucifixion. If this is so, the Epistle to the Galatians is one of the oldest, if not the very oldest, of extant documentary evidences of the state of the primitive Church. And, be it observed, if it is Paul's writing, it unquestionably furnishes us with the evidence of a participator in the transactions narrated. With the exception of two or three of the other Pauline Epistles, there is not one solitary book in the New Testament of the authorship and authority of which we have such good evidence.

[292] And what is the state of things we find disclosed? A bitter quarrel, in his account of which Paul by no means minces matters, or hesitates to hurl defiant sarcasms against those who were "reputed to be pillars": James "the brother of the Lord," Peter, the rock on whom Jesus is said to have built his Church, and John, "the beloved disciple." And no deference toward "the rock" withholds Paul from charging Peter to his face with "dissimulation."

The subject of the hot dispute was simply this. Were Gentile converts bound to obey the Law or not? Paul answered in the negative; and, acting upon his opinion, he had created at Antioch (and elsewhere) a specifically "Christian" community, the sole qualifications for admission into which were the confession of the belief that Jesus was the Messiah, and baptism upon that confession. In the epistle in question, Paul puts this–his "gospel," as he calls it–in its most extreme form. Not only does he deny the necessity of conformity with the Law, but he declares such conformity to have a negative value. "Behold, I, Paul, say unto you, that if ye receive circumcision, Christ will profit you nothing" (Galatians v. 2). He calls the legal observances "beggarly rudiments," and anathematises every one who preaches to the Galatians any other gospel than his own. That is to say, by direct consequence, he anathematises the Nazarenes of Jerusalem, whose zeal for the Law is [293] testified by James in a passage of the Acts cited further on. In the first Epistle to the Corinthians, dealing with the question of eating meat offered to idols, it is clear that Paul himself thinks it a matter of indifference; but he advises that it should not be done, for the sake of the weaker brethren. On the other hand, the Nazarenes of Jerusalem most strenuously opposed Paul's "gospel," insisting on every convert becoming a regular Jewish proselyte, and consequently on his observance of the whole Law; and this party was led by James and Peter and John (Galatians ii. 9) Paul does not suggest that the question of principle was settled by the discussion referred to in Galatians. All he says is, that it ended in the practical agreement that he and Barnabas should do as they had been doing, in respect to the Gentiles; while James and Peter and John should deal in their own fashion with Jewish converts. Afterwards, he complains bitterly of Peter, because, when on a visit to Antioch, he, at first, inclined to Paul's view and ate with the Gentile converts; but when "certain came from James," "drew back, and separated himself, fearing them that were of the circumcision. And the rest of the Jews dissembled likewise with him; insomuch that even Barnabas was carried away with their dissimulation" (Galatians ii. 12-13).

There is but one conclusion to be drawn from Paul's account of this famous dispute, the settle[294]ment of which determined the fortunes of the nascent religion. It is that the disciples at Jerusalem, headed by "James, the Lord's brother," and by the leading apostles, Peter and John, were strict Jews, who had objected to admit any converts into their body, unless these, either by birth, or by becoming proselytes,

were also strict Jews. In fact, the sole difference between James and Peter and John, with the body of the disciples whom they led and the Jews by whom they were surrounded, and with whom they, for many years, shared the religious observances of the Temple, was that they believed that the Messiah, whom the leaders of the nation yet looked for, had already come in the person of Jesus of Nazareth.

The Acts of the Apostles is hardly a very trustworthy history; it is certainly of later date than the Pauline Epistles, supposing them to be genuine. And the writer's version of the conference of which Paul gives so graphic a description, if that is correct, is unmistakably coloured with all the art of a reconciler, anxious to cover up a scandal. But it is none the less instructive on this account. The judgment of the "council" delivered by James is that the Gentile converts shall merely "abstain from things sacrificed to idols, and from blood and from things strangled, and from fornication." But notwithstanding the accommodation in which the writer of the Acts would have us believe, the Jerusalem Church held [295] to its endeavour to retain the observance of the Law. Long after the conference, some time after the writing of the Epistles to the Galatians and Corinthians, and immediately after the despatch of that to the Romans, Paul makes his last visit to Jerusalem, and presents himself to James and all the elders. And this is what the Acts tells us of the interview:–

"And they said unto him, Thou seest, brother, how many thousands [or myriads] there are among the Jews of them which have believed; and they are all zealous for the law; and they have been informed concerning thee, that thou teachest all the Jews which are among the Gentiles to forsake Moses, telling them not to circumcise their children, neither to walk after the customs." (Acts xxi. 20, 21.)

They therefore request that he should perform a certain public religious act in the Temple, in order that

"all shall know that there is no truth in the things whereof they have been informed concerning thee; but that thou thyself walkest orderly, keeping the law" (*ibid.* 24).[14]

How far Paul could do what he is here requested to do, and which the writer of the Acts goes on to say he did, with a clear conscience, if he wrote the Epistles to the Galatians and Corinthians, I may leave any candid reader of these epistles to decide. The point to which I wish to [296] direct attention is the declaration that the Jerusalem Church, led by the brother of Jesus and by his personal disciples and friends, twenty years and more after his death, consisted of strict and zealous Jews.

Tertullus, the orator, caring very little about the internal dissensions of the followers of Jesus, speaks of Paul as a "ringleader of the sect of the Nazarenes" (Acts xxiv. 5), which must have affected James much in the same way as it would have moved the Archbishop of Canterbury, in George Fox's day, to hear the latter called a "ringleader of the sect of Anglicans." In fact, "Nazarene" was, as is well known, the distinctive appellation applied to Jesus; his immediate followers were known as Nazarenes; while the congregation of the disciples, and, later, of converts at Jerusalem–the Jerusalem Church–was emphatically the "sect of the Nazarenes," no more, in itself, to be regarded as anything outside Judaism than the sect of the Sadducees, or that of the Essenes.[15] In fact, the tenets of both the Sadducees and the Essenes diverged much more widely from the Pharisaic standard of orthodoxy than Nazarenism did.

Let us consider the position of affairs now (A.D. 50-60) in relation to that which obtained in [297] Justin's time, a century later. It is plain that the Nazarenes–presided over by James, "the brother of the Lord," and comprising within their body all the twelve apostles–belonged to Justin's second category of "Jews who observe the Law, believe Jesus to be the Christ, but who insist on the observance of the Law by Gentile converts," up till the time at which the controversy reported by Paul arose. They then, according to Paul, simply allowed him to form his congregations of non-legal Gentile converts at Antioch and elsewhere; and it would seem that it was to these converts, who would come under Justin's fifth category, that the title of "Christian" was first applied. If any of these Christians had acted upon the more than half-permission given by Paul, and had eaten meats offered to idols, they would have belonged to Justin's seventh category.

Hence, it appears that, if Justin's opinion, which was probably that of the Church generally in the middle of the second century, was correct, James and Peter and John and their followers could not be saved; neither could Paul, if he carried into practice his views as to the indifference of eating meats offered to idols. Or, to put the matter another way, the centre of gravity of orthodoxy, which is at the extreme right of the series in the nineteenth century, was at the extreme left, just before the middle of the first [298] century, when the "sect of the Nazarenes" constituted the whole church founded by Jesus and the apostles; while, in the time of Justin, it lay midway between the two. It is therefore a profound mistake to imagine that the Judæo-Christians (Nazarenes and Ebionites) of later times were heretical outgrowths from a primitive universalist "Christianity." On the contrary, the universalist "Christianity" is an outgrowth from the primitive, purely Jewish, Nazarenism; which, gradually eliminating all the ceremonial and dietary parts of the Jewish law, has thrust aside its parent, and all the intermediate stages of its development, into the position of damnable heresies.

Such being the case, we are in a position to form a safe judgment of the limits within which the teaching of Jesus of Nazareth must have been confined. Ecclesiastical authority would have us believe that the words which are given at the end of the first Gospel, "Go ye, therefore, and make disciples of all the nations, baptizing them in the name of the Father and of the Son and of the Holy Ghost," are part of the last commands of Jesus, issued at the moment of his parting with the eleven. If so, Peter and John must have heard these words; they are too plain to be misunderstood; and the occasion is too solemn for them ever to be forgotten. Yet the "Acts" tells us that Peter needed a vision to enable him so [299] much as to baptize Cornelius; and Paul, in the Galatians, knows nothing of words which would have completely borne him out as against those who, though they heard, must be supposed to have either forgotten, or ignored them. On the other hand, Peter and John, who are supposed to have heard the "Sermon on the Mount," know nothing of the saying that Jesus had not come to destroy the Law, but that every jot and tittle of the Law must be fulfilled, which surely would have been pretty good evidence for their view of the question.

We are sometimes told that the personal friends and daily companions of Jesus remained zealous Jews and opposed Paul's innovations, because they were hard of heart and dull of comprehension. This hypothesis is hardly in accordance with the concomitant faith of those who adopt it, in the miraculous insight and superhuman sagacity of their Master; nor do I see any way of getting it to harmonise with the

orthodox postulate; namely, that Matthew was the author of the first gospel and John of the fourth. If that is so, then, most assuredly, Matthew was no dullard; and as for the fourth gospel–a theosophic romance of the first order–it could have been written by none but a man of remarkable literary capacity, who had drunk deep of Alexandrian philosophy. Moreover, the doctrine of the writer of the fourth gospel is more remote [300] from that of the "sect of the Nazarenes" than is that of Paul himself. I am quite aware that orthodox critics have been capable of maintaining that John, the Nazarene, who was probably well past fifty years of age, when he is supposed to have written the most thoroughly Judaising book in the New Testament–the Apocalypse–in the roughest of Greek, underwent an astounding metamorphosis of both doctrine and style by the time he reached the ripe age of ninety or so, and provided the world with a history in which the acutest critic cannot [always] make out where the speeches of Jesus end and the text of the narrative begins; while that narrative is utterly irreconcilable, in regard to matters of fact, with that of his fellow-apostle, Matthew.

The end of the whole matter is this:–The "sect of the Nazarenes," the brother and the immediate followers of Jesus, commissioned by him as apostles, and those who were taught by them up to the year 50 A.D., were not "Christians" in the sense in which that term has been understood ever since its asserted origin at Antioch, but Jews–strict orthodox Jews–whose belief in the Messiahship of Jesus never led to their exclusion from the Temple services, nor would have shut them out from the wide embrace of Judaism.[16] [301] The open proclamation of their special view about the Messiah was doubtless offensive to the Pharisees, just as rampant Low Churchism is offensive to bigoted High Churchism in our own country; or as any kind of dissent is offensive to fervid religionists of all creeds. To the Sadducees, no doubt, the political danger of any Messianic movement was serious; and they would have been glad to put down Nazarenism, lest it should end in useless rebellion against their Roman masters, like that other Galilean movement headed by Judas, a generation earlier. Galilee was always a hotbed of seditious enthusiasm against the rule of Rome; and high priest and procurator alike had need to keep a sharp eye upon natives of that district. On the whole, however, the Nazarenes were but little troubled for the first twenty years of their existence; and the undying hatred of the Jews against those later converts, whom they regarded as apostates and fautors of a sham Judaism, was awakened by Paul. From their point of view, he was a mere renegade Jew, opposed alike to orthodox Judaism and to orthodox Nazarenism; and whose teachings threatened Judaism with destruction. And, from their point of view, they were quite right. In the course of a century, Pauline influences had a large share in driving primitive Nazarenism from being the very heart of the new faith into the position of scouted error; and the spirit of Paul's doctrine continued [302] its work of driving Christianity farther and farther away from Judaism, until "meats offered to idols" might be eaten without scruple, while the Nazarene methods of observing even the Sabbath, or the Passover, were branded with the mark of Judaising heresy.

But if the primitive Nazarenes of whom the Acts speaks were orthodox Jews, what sort of probability can there be that Jesus was anything else? How can he have founded the universal religion which was not heard of till twenty years after his death?[17] That Jesus possessed, in a rare degree, the gift of attaching men to his person and to his fortunes; that he was the author of many a striking saying, and the advocate of equity, of love, and of humility; that he may have disregarded the subtleties of the bigots for legal observance, and appealed rather to those noble conceptions of religion which constituted the pith

and kernel of the teaching of the great prophets of his nation seven hundred years earlier; and that, in the last scenes of his career, he may have embodied the ideal sufferer of Isaiah, may be, as I think it is, extremely probable. But all this involves not a step beyond the borders of orthodox [303] Judaism. Again, who is to say whether Jesus proclaimed himself the veritable Messiah, expected by his nation since the appearance of the pseudo-prophetic work of Daniel, a century and a half before his time; or whether the enthusiasm of his followers gradually forced him to assume that position?

But one thing is quite certain: if that belief in the speedy second coming of the Messiah which was shared by all parties in the primitive Church, whether Nazarene or Pauline; which Jesus is made to prophesy, over and over again, in the Synoptic gospels; and which dominated the life of Christians during the first century after the crucifixion;–if he believed and taught that, then assuredly he was under an illusion, and he is responsible for that which the mere effluxion of time has demonstrated to be a prodigious error.

When I ventured to doubt "whether any Protestant theologian who has a reputation to lose will say that he believes the Gadarene story," it appears that I reckoned without Dr. Wace, who, referring to this passage in my paper, says .–

"He will judge whether I fall under his description; but I repeat that I believe it, and that he has removed the only objection to my believing it" (p. 363).

Far be it from me to set myself up as a judge [304] of any such delicate question as that put before me; but I think I may venture to express the conviction that, in the matter of courage, Dr. Wace has raised for himself a monument *ære perennius.* For really, in my poor judgment, a certain splendid intrepidity, such as one admires in the leader of a forlorn hope, is manifested by Dr. Wace when he solemnly affirms that he believes the Gadarene story on the evidence offered. I feel less complimented perhaps than I ought to do, when I am told that I have been an accomplice in extinguishing in Dr. Wace's mind the last glimmer of doubt which common sense may have suggested. In fact, I must disclaim all responsibility for the use to which the information I supplied has been put. I formally decline to admit that the expression of my ignorance whether devils, in the existence of which I do not believe, if they did exist, might or might not be made to go out of men into pigs, can, as a matter of logic, have been of any use whatever to a person who already believed in devils and in the historical accuracy of the gospels.

Of the Gadarene story, Dr. Wace, with all solemnity and twice over, affirms that he "believes it." I am sorry to trouble him further, but what does he mean by "it"? Because there are two stories, one in "Mark" and "Luke," and the other in "Matthew." In the former, which I quoted in my previous paper, there is one possessed [305] man; in the latter there are two. The story is told fully, with the vigorous homely diction and the picturesque details of a piece of folklore, in the second gospel. The immediately antecedent event is the storm on the Lake of Gennesaret. The immediately consequent events are the message from the ruler of the synagogue and the healing of the woman with an issue of blood. In the third gospel, the order of events is exactly the same, and there is an extremely close general and verbal correspondence between the narratives of the miracle. Both agree in stating that there was only one possessed man, and that he was the residence of many devils, whose name was "Legion."

In the first gospel, the event which immediately precedes the Gadarene affair is, as before, the storm; the message from the ruler and the healing of the issue are separated from it by the accounts of the healing of a paralytic, of the calling of Matthew, and of a discussion with some Pharisees. Again, while the second gospel speaks of the country of the "Gerasenes" as the locality of the event, the third gospel has "Gerasenes," "Gergesenes," and "Gadarenes" in different ancient MSS.; while the first has "Gadarenes."

The really important points to be noticed, however, in the narrative of the first gospel, are these–that there are two possessed men instead of one; and that while the story is abbreviated by [306] omissions, what there is of it is often verbally identical with the corresponding passages in the other two gospels. The most unabashed of reconcilers cannot well say that one man is the same as two, or two as one; and, though the suggestion really has been made, that two different miracles, agreeing in all essential particulars, except the number of the possessed, were effected immediately after the storm on the lake, I should be sorry to accuse any one of seriously adopting it. Nor will it be pretended that the allegory refuge is accessible in this particular case.

So, when Dr. Wace says that he believes in the synoptic evangelists' account of the miraculous bedevilment of swine, I may fairly ask which of them does he believe? Does he hold by the one evangelist's story, or by that of the two evangelists? And having made his election, what reasons has he to give for his choice? If it is suggested that the witness of two is to be taken against that of one, not only is the testimony dealt with in that common-sense fashion against which the theologians of his school protest so warmly; not only is all question of inspiration at an end, but the further inquiry arises, After all, is it the testimony of two against one? Are the authors of the versions in the second and third gospels really independent witnesses? In order to answer this question, it is only needful to place the English versions of the two side by side, and [307] compare them carefully. It will then be seen that the coincidences between them, not merely in substance, but in arrangement, and in the use of identical words in the same order, are such, that only two alternatives are conceivable: either one evangelist freely copied from the other, or both based themselves upon a common source, which may either have been a written document, or a definite oral tradition learned by heart. Assuredly, these two testimonies are not those of independent witnesses. Further, when the narrative in the first gospel is compared with that in the other two, the same fact comes out.

Supposing, then, that Dr. Wace is right in his assumption that Matthew, Mark, and Luke wrote the works which we find attributed to them by tradition, what is the value of their agreement, even that something more or less like this particular miracle occurred, since it is demonstrable, either that all depend on some antecedent statement, of the authorship of which nothing is known, or that two are dependent upon the third?

Dr. Wace says he believes the Gadarene story; whichever version of it he accepts, therefore, he believes that Jesus said what he is stated in all the versions to have said, and thereby virtually declared that the theory of the nature of the spiritual world involved in the story is true. Now I hold that this theory is false, that it is a monstrous and mischievous fiction; and I unhesi[308] tatingly express my disbelief in

any assertion that it is true, by whomsoever made. So that, if Dr. Wace is right in his belief, he is also quite right in classing me among the people he calls "infidels"; and although I cannot fulfil the eccentric expectation that I shall glory in a title which, from my point of view, it would be simply silly to adopt, I certainly shall rejoice not to be reckoned among "Christians" so long as the profession of belief in such stories as the Gadarene pig affair, on the strength of a tradition of unknown origin, of which two discrepant reports, also of unknown origin, alone remain, forms any part of the Christian faith. And, although I have, more than once, repudiated the gift of prophecy, yet I think I may venture to express the anticipation, that if "Christians" generally are going to follow the line taken by Dr. Wace, it will not be long before all men of common sense qualify for a place among the "infidels."

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[1] I may perhaps return to the question of the authorship of the Gospels. For the present I must content myself with warning my readers against any reliance upon Dr. Wace's statements as to the results arrived at by modern criticism. They are as gravely as surprisingly erroneous.

[2] The United States ought, perhaps, to be added, but I am not sure.

[3] Imagine that all our chairs of Astronomy had been founded in the fourteenth century, and that their incumbents were bound to sign Ptolemaic articles. In that case, with every respect for the efforts of persons thus hampered to attain and expound the truth, I think men of common sense would go elsewhere to learn astronomy, Zeller's *Vorträge und Abhandlungen* were published and came into my hands a quarter of a century ago. The writer's rank, as a theologian to begin with, and subsequently as a historian of Greek philosophy, is of the highest. Among these essays are two–*Das Urchristenthum* and *Die Tübinger historische Schule*–which are likely to be of more use to those who wish to know the real state of the case than all that the official "apologists," with their one eye on truth and the other on the tenets of their sect, have written. For the opinion of a scientific theologian about theologians of this stamp see pp. 225 and 227 of the *Vorträge.*

[4] I suppose this is what Dr. Wace is thinking about when he says that I allege that there "is no visible escape" from the supposition of an *Ur-Marcus* (p. 367). That a "theologian of repute" should confound an indisputable fact with one of the modes of explaining that fact is not so singular as those who are unaccustomed to the ways of theologians might imagine.

[5] Any examiner whose duty it has been to examine into a case of "copying" will be particularly well prepared to appreciate the force of the case stated in that most excellent little book *The Common Tradition of the Synoptic Gospels*, by Dr. Abbott and Mr. Rushbrooke (Macmillan, 1884). To those who have not passed through such painful experiences I may recommend the brief discussion of the genuineness of the "Casket Letters" in my friend Mr. Skelton's interesting book, *Maitland of Lethington.* The second edition of Holtzmann's *Lehrbuch*, published in 1886, gives a remarkably fair and full account of the present results of criticism. At p. 366 he writes that the present burning question is whether the "relatively primitive narrative and the root of the other synoptic texts is contained in Matthew or in Mark. It is only on this point that properly-informed (*sachkundige*) critics differ," and he decides in favour of Mark.

[6] Holtzmann (*Die synoptischen Evangelien*, 1863, p. 75) following Ewald, argues that the "source A" (= the

threefold tradition, more or less) contained something that answered to the "Sermon on the Plain" immediately after the words of our present Mark, "And he cometh into a house" (iii. l9). But what conceivable motive could "Mark" have for omitting it? Holtzmann has no doubt, however, that the "Sermon on the Mount" is a compilation, or, as he calls it in his recently-published *Lehrbuch* (p. 372), "an artificial mosaic work."

[7] See Schürer, *Geschichte des jüdischen Volkes,* Zweiter Theil, p. 384.

[8] Spacious, because a young man could sit in it "on the right side" (xv. 5), and therefore with plenty of room to spare.

[9] King Herod had not the least difficulty in supposing the resurrection of John the Baptist–"John, whom I beheaded, he is risen" (Mark vi. l6).

[10] I am very sorry for the interpolated "in," because citation ought to be accurate in small things as in great. But what difference it makes whether one "believes Jesus" or "believes in Jesus" much thought has not enabled me to discover. If you "believe him" you must believe him to be what he professed to be–that is, "believe in him;" and if you "believe in him" you must necessarily "believe him."

[11] True for Justin: but there is a school of theological critics who more or less question the historical reality of Paul, and the genuineness of even the four cardinal epistles.

[12] See *Dial. cum Tryphone,* § 47 and § 35. It is to be understood that Justin does not arrange these Categories in order, as I have done.

[13] I guard myself against being supposed to affirm that even the four cardinal epistles of Paul may not have been seriously tampered with. See note 1, p. 287 above.

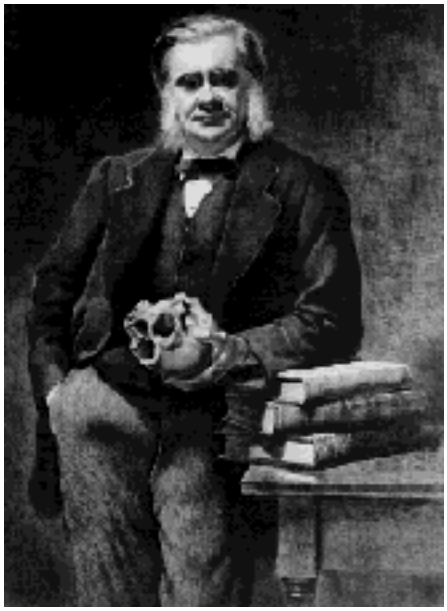
[14] [Paul, in fact, is required to commit in Jerusalem, an act of the same character as that which he brands as "dissimulation" on the part of Peter in Antioch.]

[15] All this was quite clearly pointed out by Ritschl nearly forty years ago. See *Die Entstehung der alt-katholischen Kirche* (1850), p. 108.

[16] "If every one was baptized as soon as he acknowledged Jesus to be the Messiah, the first Christians can have been aware of no other essential differences from the Jews."–Zeller, *Vorträge* (1865), p. 26.

[17] Dr. Harnack, in the lately-published second edition of his *Dogmengeschichte* says (p. 39), "Jesus Christ brought forward no new doctrine;" and again (p. 65), "It is not difficult to set against every portion of the utterances of Jesus an observation which deprives him of originality." See also Zusatz 4, on the same page.

THE HUXLEY FILE



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Agnosticism and Christianity [1899]

Collected Essays V

[309] Nemo ergo ex me scire quærat, quod me nescire scio, nisi forte ut nescire discat.–Augustinus, *De Civ. Dei,* xii.7.

[1] The present discussion has arisen out of the use, which has become general in the last few years, of the terms "Agnostic" and "Agnosticism."

The people who call themselves "Agnostics" have been charged with doing so because they have not the courage to declare themselves "Infidels." It has been insinuated that they have adopted a new name in order to escape the unpleasantness which attaches to their proper denomination. To this wholly erroneous imputation, I have replied by showing that the term "Agnostic" did, as a matter of fact, arise in a manner which negatives it; and my statement has not been, and cannot be, refuted. Moreover, [310] speaking for myself, and without impugning the right of any other person to use the term in another sense, I further say that Agnosticism is not properly described as a "negative" creed, nor indeed as a creed of any kind, except in so far as it expresses absolute faith in the validity of a principle, which is as much ethical as intellectual. This principle may be stated in various ways, but they all amount to this: that it is wrong for a man to say that he is certain of the objective truth of any proposition unless he can produce evidence which logically justifies that certainty. This is what Agnosticism asserts; and, in my opinion, it is all that is essential to Agnosticism. That which Agnostics deny and repudiate, as immoral, is the contrary doctrine, that there are propositions which men ought to believe, without logically satisfactory evidence; and that reprobation ought to attach to the profession of disbelief in such inadequately supported propositions. The justification of the Agnostic principle lies in the success which follows upon its application, whether in the field of natural, or in that of civil, history; and in the fact that, so far as these topics are concerned, no sane man thinks of denying its validity.

Still speaking for myself, I add, that though Agnosticism is not, and cannot be, a creed, except in so far as its general principle is concerned; yet that

the application of that principle results in [311] the denial of, or the suspension of judgment concerning, a number of propositions respecting which our contemporary ecclesiastical "gnostics" profess entire certainty. And, in so far as these ecclesiastical persons can be justified in their old-established custom (which many nowadays think more honoured in the breach than the observance) of using opprobrious names to those who differ from them, I fully admit their right to call me and those who think with me "Infidels"; all I have ventured to urge is that they must not expect us to speak of ourselves by that title.

The extent of the region of the uncertain, the number of the problems the investigation of which ends in a verdict of not proven, will vary according to the knowledge and the intellectual habits of the individual Agnostic. I do not very much care to speak of anything as "unknowable."[2] What I am sure about is that there are many topics about which I know nothing; and which, so far as I can see, are out of reach of my faculties. But whether these things are knowable by any one else is exactly one of those matters which is beyond my knowledge, though I may have a tolerably strong opinion as to the probabilities of the case. Relatively to myself, I am quite sure that the region of uncertainty–the nebulous country in which words play the part of realities [312]–is far more extensive than I could wish. Materialism and Idealism; Theism and Atheism; the doctrine of the soul and its mortality or immortality–appear in the history of philosophy like the shades of Scandinavian heroes, eternally slaying one another and eternally coming to life again in a metaphysical "Nifelheim." It is getting on for twenty-five centuries, at least, since mankind began seriously to give their minds to these topics. Generation after generation, philosophy has been doomed to roll the stone uphill; and, just as all the world swore it was at the top, down it has rolled to the bottom again. All this is written in innumerable books; and he who will toil through them will discover that the stone is just where it was when the work began. Hume saw this; Kant saw it; since their time, more and more eyes have been cleansed of the films which prevented them from seeing it; until now the weight and number of those who refuse to be the prey of verbal mystifications has begun to tell in practical life.

It was inevitable that a conflict should arise between Agnosticism and Theology; or rather, I ought to say, between Agnosticism and

Ecclesiasticism. For Theology, the science, is one thing; and Ecclesiasticism, the championship of a foregone conclusion[3] as to the truth of a particular [313] form of Theology, is another. With scientific Theology, Agnosticism has no quarrel. On the contrary, the Agnostic, knowing too well the influence of prejudice and idiosyncrasy, even on those who desire most earnestly to be impartial, can wish for nothing more urgently than that the scientific theologian should not only be at perfect liberty to thresh out the matter in his own fashion; but that he should, if he can, find flaws in the Agnostic position; and, even if demonstration is not to be had, that he should put, in their full force, the grounds of the conclusions he thinks probable. The scientific theologian admits the Agnostic principle, however widely his results may differ from those reached by the majority of Agnostics.

But, as between Agnosticism and Ecclesiasticism, or, as our neighbours across the Channel call it, Clericalism, there can be neither peace nor truce. The Cleric asserts that it is morally wrong not to believe certain propositions, whatever the results of a strict scientific investigation of the evidence of these propositions. He tells us "that religious error is, in itself, of an immoral nature."[4] He declares that he has prejudged certain conclusions, and looks upon those who show cause for arrest of judgment as emissaries of Satan. It necessarily follows that, for him, the attainment of faith, not the ascertainment of truth, is the [314] highest aim of mental life. And, on careful analysis of the nature of this faith, it will too often be found to be, not the mystic process of unity with the Divine, understood by the religious enthusiast; but that which the candid simplicity of a Sunday scholar once defined it to be. "Faith," said this unconscious plagiarist of Tertullian, "is the power of saying you believe things which are incredible."

Now I, and many other Agnostics, believe that faith, in this sense, is an abomination; and though we do not indulge in the luxury of self-righteousness so far as to call those who are not of our way of thinking hard names, we do feel that the disagreement between ourselves and those who hold this doctrine is even more moral than intellectual. It is desirable there should be an end of any mistakes on this topic. If our clerical opponents were clearly aware of the real state of the case, there would be an end of the curious delusion, which often appears between the lines of their writings,

that those whom they are so fond of calling "Infidels" are people who not only ought to be, but in their hearts are, ashamed of themselves. It would be discourteous to do more than hint the antipodal opposition of this pleasant dream of theirs to facts.

The clerics and their lay allies commonly tell us, that if we refuse to admit that there is good ground for expressing definite convictions about [315] certain topics, the bonds of human society will dissolve and mankind lapse into savagery. There are several answers to this assertion. One is that the bonds of human society were formed without the aid of their theology; and, in the opinion of not a few competent judges, have been weakened rather than strengthened by a good deal of it. Greek science, Greek art, the ethics of old Israel, the social organisation of old Rome, contrived to come into being, without the help of any one who believed in a single distinctive article of the simplest of the Christian creeds. The science, the art, the jurisprudence, the chief political and social theories, of the modern world have grown out of those of Greece and Rome–not by favour of, but in the teeth of, the fundamental teachings of early Christianity, to which science, art, and any serious occupation with the things of this world, were alike despicable.

Again, all that is best in the ethics of the modern world, in so far as it has not grown out of Greek thought, or Barbarian manhood, is the direct development of the ethics of old Israel. There is no code of legislation, ancient or modern, at once so just and so merciful, so tender to the weak and poor, as the Jewish law; and, if the Gospels are to be trusted, Jesus of Nazareth himself declared that he taught nothing but that which lay implicitly, or explicitly, in the religious and ethical system of his people.

[316] "And the scribe said unto him, Of a truth, Teacher; thou hast well said that he is one; and there is none other but he and to love him with all the heart, and with all the understanding, and with all the strength, and to love his neighbour as himself, is much more than all whole burnt offerings and sacrifices." (Mark xii. 32, 33.)

Here is the briefest of summaries of the teaching of the prophets of Israel of the eighth century; does the Teacher, whose doctrine is thus set forth in his presence, repudiate the exposition? Nay; we are told, on the contrary, that Jesus saw that he "answered discreetly," and replied, "Thou art not far from

the kingdom of God."

So that I think that even if the creeds, from the so-called "Apostles'" to the so-called "Athanasian," were swept into oblivion; and even if the human race should arrive at the conclusion that, whether a bishop washes a cup or leaves it unwashed, is not a matter of the least consequence, it will get on very well. The causes which have led to the development of morality in mankind, which have guided or impelled us all the way from the savage to the civilised state, will not cease to operate because a number of ecclesiastical hypotheses turn out to be baseless. And, even if the absurd notion that morality is more the child of speculation than of practical necessity and inherited instinct, had any foundation; if all the world is going to thieve, murder, and otherwise misconduct itself as soon as it discovers that [317] certain portions of ancient history are mythical; what is the relevance of such arguments to any one who holds by the Agnostic principle?

Surely, the attempt to cast out Beelzebub by the aid of Beelzebub is a hopeful procedure as compared to that of preserving morality by the aid of immorality. For I suppose it is admitted that an Agnostic may be perfectly sincere, may be competent, and may have studied the question at issue with as much care as his clerical opponents. But, if the Agnostic really believes what he says, the "dreadful consequence" argufier (consistently, I admit, with his own principles) virtually asks him to abstain from telling the truth, or to say what he believes to be untrue, because of the supposed injurious consequences to morality. "Beloved brethren, that we may be spotlessly moral, before all things let us lie," is the sum total of many an exhortation addressed to the "Infidel." Now, as I have already pointed out, we cannot oblige our exhorters. We leave the practical application of the convenient doctrines of "Reserve" and "Non-natural interpretation" to those who invented them.

I trust that I have now made amends for any ambiguity, or want of fulness, in my previous exposition of that which I hold to be the essence of the Agnostic doctrine. Henceforward, I might hope to hear no more of the assertion that we are necessarily Materialists, Idealists, Atheists, Theists, or any other *ists,* if experience had led me to think that the proved falsity of a

statement was any guarantee against its repetition. And those who appreciate the nature of our position will see, at once, that when Ecclesiasticism declares that we ought to believe this, that, and the other, and are very wicked if we don't, it is impossible for us to give any answer but this: We have not the slightest objection to believe anything you like, if you will give us good grounds for belief; but, if you cannot, we must respectfully refuse, even if that refusal should wreck morality and insure our own damnation several times over. We are quite content to leave that to the decision of the future. The course of the past has impressed us with the firm conviction that no good ever comes of falsehood, and we feel warranted in refusing even to experiment in that direction.

In the course of the present discussion it has been asserted that the "Sermon on the Mount" and the "Lord's Prayer" furnish a summary and condensed view of the essentials of the teaching of Jesus of Nazareth, set forth by himself. Now this supposed *Summa* of Nazarene theology distinctly affirms the existence of a spiritual world, of a Heaven, and of a Hell of fire; it teaches the Fatherhood of God and the malignity of the Devil; it declares the superintending providence of the former and our need of deliverance from the [319] machinations of the latter; it affirms the fact of demoniac possession and the power of casting out devils by the faithful. And, from these premises, the conclusion is drawn, that those Agnostics who deny that there is any evidence of such a character as to justify certainty, respecting the existence and the nature of the spiritual world, contradict the express declarations of Jesus. I have replied to this argumentation by showing that there is strong reason to doubt the historical accuracy of the attribution to Jesus of either the "Sermon on the Mount" or the "Lord's Prayer"; and, therefore, that the conclusion in question is not warranted, at any rate, on the grounds set forth.

But, whether the Gospels contain trustworthy statements about this and other alleged historical facts or not, it is quite certain that from them, taken together with the other books of the New Testament, we may collect a pretty complete exposition of that theory of the spiritual world which was held by both Nazarenes and Christians; and which was undoubtedly supposed by them to be fully sanctioned by Jesus, though it is just as clear that they did not imagine it contained any revelation by him of something heretofore

unknown. If the pneumatological doctrine which pervades the whole New Testament is nowhere systematically stated, it is everywhere assumed. The writers of the Gospels and of the Acts take it [320] for granted, as a matter of common knowledge; and it is easy to gather from these sources a series of propositions, which only need arrangement to form a complete system.

In this system, Man is considered to be a duality formed of a spiritual element, the soul; and a corporeal element, the body. And this duality is repeated in the Universe, which consists of a corporeal[5] world embraced and interpenetrated by a spiritual world. The former consists of the earth, as its principal and central constituent, with the subsidiary sun, planets, and stars. Above the earth is the air, and below is the watery abyss. Whether the heaven, which is conceived to be above the air, and the hell in, or below, the subterranean deeps, are to be taken as corporeal or incorporeal is not clear. However this may be, the heaven and the air, the earth and the abyss, are peopled by innumerable beings analogous in nature to the spiritual element in man, and these spirits are of two kinds, good and bad. The chief of the good spirits, infinitely superior to all the others, and their creator, as well as the creator of the corporeal world and of the bad spirits, is God. [321] His residence is heaven, where he is surrounded by the ordered hosts of good spirits; his angels, or messengers, and the executors of his will throughout the universe.

On the other hand, the chief of the bad spirits is Satan, *the* devil *par excellence.* He and his company of demons are free to roam through all parts of the universe, except the heaven. These bad spirits are far superior to man in power and subtlety; and their whole energies are devoted to bringing physical and moral evils upon him, and to thwarting, so far as their power goes, the benevolent intentions of the Supreme Being. In fact, the souls and bodies of men form both the theatre and the prize of an incessant warfare between the good and the evil spirits–the powers of light and the powers of darkness. By leading Eve astray, Satan brought sin and death upon mankind. As the gods of the heathen, the demons are the founders and maintainers of idolatry; as the "powers of the air" they afflict mankind with pestilence and famine; as "unclean spirits" they cause disease of mind and body.

The significance of the appearance of Jesus, in the capacity of the Messiah, or Christ, is the reversal of the satanic work by putting an end to both sin and death. He announces that the kingdom of God is at hand, when the "Prince of this world" shall be finally "cast out" (John xii. 31) from the cosmos, as Jesus, during his earthly [322] career, cast him out from individuals. Then will Satan and all his devilry, along with the wicked whom they have seduced to their destruction, be hurled into the abyss of unquenchable fire–there to endure continual torture, without a hope of winning pardon from the merciful God, their Father; or of moving the glorified Messiah to one more act of pitiful intercession; or even of interrupting, by a momentary sympathy with their wretchedness, the harmonious psalmody of their brother angels and men, eternally lapped in bliss unspeakable.

The straitest Protestant, who refuses to admit the existence of any source of Divine truth, except the Bible, will not deny that every point of the pneumatological theory here set forth has ample scriptural warranty. The Gospels, the Acts, the Epistles, and the Apocalypse assert the existence of the devil, of his demons and of Hell, as plainly as they do that of God and his angels and Heaven. It is plain that the Messianic and the Satanic conceptions of the writers of these books are the obverse and the reverse of the same intellectual coinage. If we turn from Scripture to the traditions of the Fathers and the confessions of the Churches, it will appear that, in this one particular, at any rate, time has brought about no important deviation from primitive belief. From Justin onwards, it may often be a fair question whether God, or the devil, occupies [323] a larger share of the attention of the Fathers. It is the devil who instigates the Roman authorities to persecute; the gods and goddesses of paganism are devils, and idolatry itself is an invention of Satan; if a saint falls away from grace, it is by the seduction of the demon; if heresy arises, the devil has suggested it; and some of the Fathers[6] go so far as to challenge the pagans to a sort of exorcising match, by way of testing the truth of Christianity. Mediæval Christianity is at one with patristic, on this head. The masses, the clergy, the theologians, and the philosophers alike, live and move and have their being in a world full of demons, in which sorcery and possession are everyday occurrences. Nor did the Reformation make any difference. Whatever else Luther assailed, he left the traditional demonology untouched; nor could

any one have entertained a more hearty and uncompromising belief in the devil, than he and, at a later period, the Calvinistic fanatics of New England did. Finally, in these last years of the nineteenth century, the demonological hypotheses of the first century are, explicitly or implicitly, held and occasionally acted upon by the immense majority of Christians of all confessions.

[324] Only here and there has the progress of scientific thought, outside the ecclesiastical world, so far affected Christians, that they and their teachers fight shy of the demonology of their creed. They are fain to conceal their real disbelief in one half of Christian doctrine by judicious silence about it; or by flight to those refuges for the logically destitute, accommodation or allegory. But the faithful who fly to allegory in order to escape absurdity resemble nothing so much as the sheep in the fable who–to save their lives–jumped into the pit. The allegory pit is too commodious, is ready to swallow up so much more than one wants to put into it. If the story of the temptation is an allegory; if the early recognition of Jesus as the Son of God by the demons is an allegory; if the plain declaration of the writer of the first Epistle of John (iii. 8), "To this end was the Son of God manifested, that He might destroy the works of the devil," is allegorical, then the Pauline version of the Fall may be allegorical, and still more the words of consecration of the Eucharist, or the promise of the second coming; in fact, there is not a dogma of ecclesiastical Christianity the scriptural basis of which may not be whittled away by a similar process.

As to accommodation, let any honest man who can read the New Testament ask himself whether Jesus and his immediate friends and disciples can [325] be dishonoured more grossly than by the supposition that they said and did that which is attributed to them; while, in reality, they disbelieved in Satan and his demons, in possession and in exorcism?[7]

An eminent theologian has justly observed that we have no right to look at the propositions of the Christian faith with one eye open and the other shut. (Tract 85, p. 29.) It really is not permissible to see, with one eye, that Jesus is affirmed to declare the personality and the Fatherhood of God, His loving providence and His accessibility to prayer; and to shut the other to the no less definite teaching ascribed to Jesus, in regard to the personality and the

misanthropy of the devil, his malignant watchfulness, and his subjection to exorcistic formulæ and rites. Jesus is made to say that the devil "was a murderer from the beginning" (John viii. 44) by the same authority as that upon which we depend for his asserted declaration that "God is a spirit" (John iv. 24).

To those who admit the authority of the famous Vincentian dictum that the doctrine which has been held "always, everywhere, and by all" is to be received as authoritative, the demonology must possess a higher sanction than any other Christian dogma, except, perhaps, those of the Resurrection and of the Messiahship of Jesus; [326] for it would be difficult to name any other points of doctrine on which the Nazarene does not differ from the Christian, and the different historical stages and contemporary subdivisions of Christianity from one another. And, if the demonology is accepted, there can be no reason for rejecting all those miracles in which demons play a part. The Gadarene story fits into the general scheme of Christianity; and the evidence for "Legion" and their doings is just as good as any other in the New Testament for the doctrine which the story illustrates.

It was with the purpose of bringing this great fact into prominence; of getting people to open both their eyes when they look at Ecclesiasticism; that I devoted so much space to that miraculous story which happens to be one of the best types of its class. And I could not wish for a better justification of the course I have adopted, than the fact that my heroically consistent adversary has declared his implicit belief in the Gadarene story and (by necessary consequence) in the Christian demonology as a whole. It must be obvious, by this time, that, if the account of the spiritual world given in the New Testament, professedly on the authority of Jesus, is true, then the demonological half of that account must be just as true as the other half. And, therefore, those who question the demonology, or try to explain it away, deny the truth of what Jesus [327] said, and are, in ecclesiastical terminology, "infidels" just as much as those who deny the spirituality of God. This is as plain as anything can well be, and the dilemma for my opponent was either to assert that the Gadarene pig-bedevilment actually occurred, or to write himself down an "Infidel." As was to be expected, he chose the former alternative; and I may express my great satisfaction at finding that there is one spot of common ground on which

both he and I stand. So far as I can judge, we are agreed to state one of the broad issues between the consequences of agnostic principles (as I draw them), and the consequences of ecclesiastical dogmatism (as he accepts it), as follows.

Ecclesiasticism says: The demonology of the Gospels is an essential part of that account of that spiritual world, the truth of which it declares to be certified by Jesus.

Agnosticism (*me judice*) says: There is no good evidence of the existence of a demoniac spiritual world, and much reason for doubting it.

Hereupon the ecclesiastic may observe: Your doubt means that you disbelieve Jesus; therefore you are an "Infidel" instead of an "Agnostic." To which the agnostic may reply: No; for two reasons: first, because your evidence that Jesus said what you say he said is worth very little; and secondly, because a man may be an agnostic, in the sense of admitting he has no positive [328] knowledge, and yet consider that he has more or less probable ground for accepting any given hypothesis about the spiritual world. Just as a man may frankly declare that he has no means of knowing whether the planets generally are inhabited or not, and yet may think one of the two possible hypotheses more likely than the other, so he may admit that he has no means of knowing anything about the spiritual world, and yet may think one or other of the current views on the subject, to some extent, probable.

The second answer is so obviously valid that it needs no discussion. I draw attention to it simply in justice to those agnostics who may attach greater value than I do to any sort of pneumatological speculations; and not because I wish to escape the responsibility of declaring that, whether Jesus sanctioned the demonological part of Christianity or not, I unhesitatingly reject it. The first answer, on the other hand, opens up the whole question of the claim of the biblical and other sources, from which hypotheses concerning the spiritual world are derived, to be regarded as unimpeachable historical evidence as to matters of fact.

Now, in respect of the trustworthiness of the Gospel narratives, I was

anxious to get rid of the common assumption that the determination of the authorship and of the dates of these works is a matter of fundamental importance. That assump[329]tion is based upon the notion that what contemporary witnesses say must be true, or, at least, has always a *prima facie* claim to be so regarded; so that if the writers of any of the Gospels were contemporaries of the events (and still more if they were in the position of eye-witnesses) the miracles they narrate must be historically true, and, consequently, the demonology which they involve must be accepted. But the story of the "Translation of the blessed martyrs Marcellinus and Petrus," and the other considerations (to which endless additions might have been made from the Fathers and the mediæval writers) set forth in a preceding essay, yield, in my judgment, satisfactory proof that, where the miraculous is concerned, neither considerable intellectual ability, nor undoubted honesty, nor knowledge of the world, nor proved faithfulness as civil historians, nor profound piety, on the part of eye-witnesses and contemporaries, affords any guarantee of the objective truth of their statements, when we know that a firm belief in the miraculous was ingrained in their minds, and was the pre-supposition of their observations and reasonings.

Therefore, although it be, as I believe, demonstrable that we have no real knowledge of the authorship, or of the date of composition of the Gospels, as they have come down to us, and that nothing better than more or less probable guesses can be arrived at on that subject, I have [330] not cared to expend any space on the question. It will be admitted, I suppose, that the authors of the works attributed to Matthew, Mark, Luke, and John, whoever they may be, are personages whose capacity and judgment in the narration of ordinary events are not quite so well certified as those of Eginhard; and we have seen what the value of Eginhard's evidence is when the miraculous is in question.

I have been careful to explain that the arguments which I have used in the course of this discussion are not new; that they are historical and have nothing to do with what is commonly called science; and that they are all, to the best of my belief, to be found in the works of theologians of repute.

The position which I have taken up, that the evidence in favour of such

miracles as those recorded by Eginhard, and consequently of mediæval demonology, is quite as good as that in favour of such miracles as the Gadarene, and consequently of Nazarene demonology, is none of my discovery. Its strength was, wittingly or unwittingly, suggested, a century and a half ago, by a theological scholar of eminence; and it has been, if not exactly occupied, yet so fortified with bastions and redoubts by a living ecclesiastical Vauban, that, in my judgment, it has been rendered impregnable. In the early part of the last [331] century, the ecclesiastical mind in this country was much exercised by the question, not exactly of miracles, the occurrence of which in biblical times was axiomatic, but by the problem: When did miracles cease? Anglican divines were quite sure that no miracles had happened in their day, nor for some time past; they were equally sure that they happened sixteen or seventeen centuries earlier. And it was a vital question for them to determine at what point of time, between this *terminus a quo* and that *terminus ad quem,* miracles came to an end.

The Anglicans and the Romanists agreed in the assumption that the possession of the gift of miracle-working was *prima facie* evidence of the soundness of the faith of the miracle-workers. The supposition that miraculous powers might be wielded by heretics (though it might be supported by high authority) led to consequences too frightful to be entertained by people who were busied in building their dogmatic house on the sands of early Church history. If, as the Romanists maintained, an unbroken series of genuine miracles adorned the records of their Church, throughout the whole of its existence, no Anglican could lightly venture to accuse them of doctrinal corruption. Hence, the Anglicans, who indulged in such accusations, were bound to prove the modern, the mediæval Roman, and the later Patristic, miracles false; and to shut off the wonder-working [332] power from the Church at the exact point of time when Anglican doctrine ceased and Roman doctrine began. With a little adjustment–a squeeze here and a pull there–the Christianity of the first three or four centuries might be made to fit, or seem to fit, pretty well into the Anglican scheme. So the miracles, from Justin say to Jerome, might be recognised; while, in later times, the Church having become "corrupt"–that is to say, having pursued one and the same line of development further than was pleasing to Anglicans–its alleged miracles must needs be shams and impostures.

Under these circumstances, it may be imagined that the establishment of a scientific frontier between the earlier realm of supposed fact and the later of asserted delusion, had its difficulties; and torrents of theological special pleading about the subject flowed from clerical pens; until that learned and acute Anglican divine, Conyers Middleton, in his "Free Inquiry," tore the sophistical web they had laboriously woven to pieces, and demonstrated that the miracles of the patristic age, early and late, must stand or fall together, inasmuch as the evidence for the later is just as good as the evidence for the earlier wonders. If the one set are certified by contemporaneous witnesses of high repute, so are the other; and, in point of probability, there is not a pin to choose between the two. That is the solid and irrefrag[333]able result of Middleton's contribution to the subject. But the Free Inquirer's freedom had its limits; and he draws a sharp line of demarcation between the patristic and the New Testament miracles–on the professed ground that the accounts of the latter, being inspired, are out of the reach of criticism.

A century later, the question was taken up by another divine, Middleton's equal in learning and acuteness, and far his superior in subtlety and dialetic skill; who, though an Anglican, scorned the name of Protestant; and, while yet a Churchman, made it his business, to parade, with infinite skill, the utter hollowness of the arguments of those of his brother Churchmen who dreamed that they could be both Anglicans and Protestants. The argument of the "Essay on the Miracles recorded in the Ecclesiastical History of the Early Ages"[8] by the present [1889] Roman Cardinal, but then Anglican Doctor, John Henry Newman, is compendiously stated by himself in the following passage:–

"If the miracles of Church history cannot be defended by the arguments of Leslie, Lyttleton, Paley, or Douglas, how many of the Scripture miracles satisfy their conditions?" (p. cvii).

And, although the answer is not given in so many words, little doubt is left on the mind of the [334] reader, that, in the mind of the writer, it is: None. In fact, this conclusion is one which cannot be resisted, if the argument in favour of the Scripture miracles is based upon that which laymen, whether lawyers, or men of science, or historians, or ordinary men of affairs, call evidence. But there is something really impressive in the magnificent

contempt with which, at times, Dr. Newman sweeps aside alike those who offer and those who demand such evidence.

"Some infidel authors advise us to accept no miracles which would not have a verdict in their favour in a court of justice; that is, they employ against Scripture a weapon which Protestants would confine to attacks upon the Church; as if moral and religious questions required legal proof, and evidence were the test of truth"[9] (p. cvii).

"As if evidence were the test of truth"!–although the truth in question is the occurrence, or the non-occurrence, of certain phenomena at a certain time and in a certain place. This sudden revelation of the great gulf fixed between the ecclesiastical and the scientific mind is enough to take away the breath of any one unfamiliar with the clerical organon. As if, one may retort, the assumption that miracles may, or have, served a moral or a religious end, in any way alters the fact that they profess to be historical events, things that actually [335] happened; and, as such, must needs be exactly those subjects about which evidence is appropriate and legal proofs (which are such merely because they afford adequate evidence) may be justly demanded. The Gadarene miracle either happened, or it did not. Whether the Gadarene "question" is moral or religious, or not, has nothing to do with the fact that it is a purely historical question whether the demons said what they are declared to have said, and the devil-possessed pigs did, or did not, rush over the heights bounding the Lake of Gennesaret on a certain day of a certain year, after A.D. 26 and before A.D. 36: for vague and uncertain as New Testament chronology is, I suppose it may be assumed that the event in question, if it happened at all, took place during the procuratorship of Pilate. If that is not a matter about which evidence ought to be required, and not only legal, but strict scientific proof demanded by sane men who are asked to believe the story–what is? Is a reasonable being to be seriously asked to credit statements, which, to put the case gently, are not exactly probable, and on the acceptance or rejection of which his whole view of life may depend, without asking for as much "legal" proof as would send an alleged pickpocket to gaol, or as would suffice to prove the validity of a disputed will?

"Infidel authors" (if, as I am assured, I may answer for them) will decline to waste time on [336] mere darkenings of counsel of this sort; but to those Anglicans who accept his premises, Dr. Newman is a truly formidable

antagonist. What, indeed, are they to reply when he puts the very pertinent question:–

"whether persons who not merely question, but prejudge the Ecclesiastical miracles on the ground of their want of resemblance, whatever that be, to those contained in Scripture–as if the Almighty could not do in the Christian Church what He had not already done at the time of its foundation, or under the Mosaic Covenant–whether such reasoners are not siding with the sceptic,"

and

"whether it is not a happy inconsistency by which they continue to believe the Scriptures while they reject the Church"[10] (p. liii).

Again, I invite Anglican orthodoxy to consider this passage:–

"the narrative of the combats of St. Antony with evil spirits, is a development rather than a contradiction of revelation, viz. of such texts as speak of Satan being cast out by prayer and fasting. To be shocked, then, at the miracles of Ecclesiastical history, or to ridicule them for their strangeness, is no part of a scriptural philosophy" (pp. liii-liv).

Further on, Dr. Newman declares that it has been admitted

"that a distinct line can be drawn in point of character and circumstance between the miracles of Scripture and of Church [337] history; but this is by no means the case (p. 1v).... specimens are not wanting in the history of the Church, of miracles as awful in their character and as momentous in their effects as those which are recorded in Scripture. The fire interrupting the rebuilding of the Jewish temple, and the death of Arias, are instances, in Ecclesiastical history, of such solemn events. On the other hand, difficult instances in the Scripture history are such as these: the serpent in Eden, the Ark, Jacob's vision for the multiplication of his cattle, the speaking of Balaam's ass, the axe swimming at Elisha's word, the miracle on the swine, and various instances of prayers or prophecies, in which, as in that of Noah's blessing and curse, words which seem the result of private feeling are expressly or virtually ascribed to a Divine suggestion" (p. 1vi).

Who is to gainsay our ecclesiastical authority here? "Infidel authors" might be accused of a wish to ridicule the Scripture miracles by putting them on a level with the remarkable story about the fire which stopped the rebuilding of the Temple, or that about the death of Arius–but Dr. Newman is above suspicion. The pity is that his list of what he delicately terms "difficult" instances is so short. Why omit the manufacture of Eve out of Adam's rib, on the strict historical accuracy of which the chief argument of the

defenders of an iniquitous portion of our present marriage law depends? Why leave out the account of the "Bene Elohim" and their gallantries, on which a large part of the worst practices of the mediæval inquisitors into witchcraft was based? Why forget the angel who wrestled with Jacob, and, as the account suggests, somewhat [338] over-stepped the bound of fair play, at the end of the struggle? Surely, we must agree with Dr. Newman that, if all these camels have gone down, it savours of affectation to strain at such gnats as the sudden ailment of Arius in the midst of his deadly, if prayerful,[11] enemies; and the fiery explosion which stopped the Julian building operations. Though the *words* of the "Conclusion" of the "Essay on Miracles" may, perhaps, be quoted against me, I may express my satisfaction at finding myself in substantial accordance with a theologian above all suspicion of heterodoxy. With all my heart, I can declare my belief that there is just as good reason for believing in the miraculous slaying of the man who fell short of the Athanasian power of affirming contradictories, with respect to the nature of the Godhead, as there is for believing in the stories of the serpent and the ark told in Genesis, the speaking of Balaam's ass in Numbers, or the floating of the axe, at Elisha's order, in the second book of Kings.

It is one of the peculiarities of a really sound [339] argument that it is susceptible of the fullest development; and that it sometimes leads to conclusions unexpected by those who employ it. To my mind, it is impossible to refuse to follow Dr. Newman when he extends his reasoning, from the miracles of the patristic and mediæval ages backward in time, as far as miracles are recorded. But, if the rules of logic are valid, I feel compelled to extend the argument forwards to the alleged Roman miracles of the present day, which Dr. Newman might not have admitted, but which Cardinal Newman may hardly reject. Beyond question, there is as good, or perhaps better, evidence for the miracles worked by our Lady of Lourdes, as there is for the floating of Elisha's axe, or the speaking of Balaam's ass. But we must go still further; there is a modern system of thaumaturgy and demonology which is just as well certified as the ancient.[12] Veracious, excellent, [340] sometimes learned and acute persons, even philosophers of no mean pretensions, testify to the "levitation" of bodies much heavier than Elisha's axe; to the existence of "spirits" who, to the mere tactile sense, have been indistinguishable from flesh and blood; and, occasionally, have

wrestled with all the vigour of Jacob's opponent; yet, further, to the speech, in the language of raps, of spiritual beings, whose discourses, in point of coherence and value, are far inferior to that of Balaam's humble but sagacious steed. I have not the smallest doubt that, if these were persecuting times, there is many a worthy "spiritualist" who would cheerfully go to the stake in support of his pneumatological faith; and furnish evidence, after Paley's own heart, in proof of the truth of his doctrines. Not a few modern divines, doubtless struck by the impossibility of refusing the spiritualist evidence, if the ecclesiastical evidence is accepted, and deprived of any *a priori* objection by their implicit belief in Christian Demonology, show themselves ready to take poor Sludge seriously, and to believe that he is possessed by other devils than those of need, greed, and vainglory.

Under these circumstances, it was to be [341] expected, though it is none the less interesting to note the fact, that the arguments of the latest school of "spiritualists" present a wonderful family likeness to those which adorn the subtle disquisitions of the advocate of ecclesiastical miracles of forty years ago. It is unfortunate for the "spiritualists" that, over and over again, celebrated and trusted media, who really, in some respects, call to mind the Montanist[13] and gnostic seers of the second century, are either proved in courts of law to be fraudulent impostors; or, in sheer weariness, as it would seem, of the honest dupes who swear by them, spontaneously confess their long-continued iniquities, as the Fox women did the other day in New York.[14] But, whenever a catastrophe of this kind takes place, the believers are no wise dismayed by it. They freely admit that not only the media, but the spirits whom they summon, are sadly apt to lose sight of the elementary principles of right and wrong; and they triumphantly ask: How does the occurrence of [342] occasional impostures disprove the genuine manifestations (that is to say, all those which have not yet been proved to be impostures or delusions)? And, in this, they unconsciously plagiarise from the churchman, who just as freely admits that many ecclesiastical miracles may have been forged; and asks, with calm contempt, not only of legal proofs, but of common-sense probability, Why does it follow that none are to be supposed genuine? I must say, however, that the spiritualists, so far as I know, do not venture to outrage right reason so boldly as the ecclesiastics. They do not sneer at "evidence"; nor repudiate the

requirement of legal proofs. In fact, there can be no doubt that the spiritualists produce better evidence for their manifestations than can be shown either for the miraculous death of Arius, or for the Invention of the Cross.[15]

From the "levitation" of the axe at one end of a period of near three thousand years to the "levitation" of Sludge & Co. at the other end, there is a complete continuity of the miraculous, with every gradation, from the childish to the stupendous, from the gratification of a caprice to the illustration of sublime truth. There is no [343] drawing a line in the series that might be set out of plausibly attested cases of spiritual intervention. If one is true, all may be true; if one is false, all may be false.

This is, to my mind, the inevitable result of that method of reasoning which is applied to the confutation of Protestantism, with so much success, by one of the acutest and subtlest disputants who have ever championed Ecclesiasticism–and one cannot put his claims to acuteness and subtlety higher.

". . . the Christianity of history is not Protestantism. If ever there were a safe truth it is this.... 'To be deep in history is to cease to be a Protestant.'"[16]

I have not a shadow of doubt that these anti-Protestant epigrams are profoundly true. But I have as little that, in the same sense, the "Christianity of history is not" Romanism; and that to be deeper in history is to cease to be a Romanist. The reasons which compel my doubts about the compatibility of the Roman doctrine, or any other form of Catholicism, with history, arise out of exactly the same line of argument as that adopted by Dr. Newman in the famous essay which I have just cited. If, with one hand, Dr. Newman has destroyed Protestantism, he has [344] annihilated Romanism with the other; and the total result of his ambidextral efforts is to shake Christianity to its foundations. Nor was any one better aware that this must be the inevitable result of his arguments–if the world should refuse to accept Roman doctrines and Roman miracles–than the writer of Tract 85.

Dr. Newman made his choice and passed over to the Roman Church half a century ago. Some of those who were essentially in harmony with his views

preceded, and many followed him. But many remained; and, as the quondam Puseyite and present Ritualistic party, they are continuing that work of sapping and mining the Protestantism of the Anglican Church which he and his friends so ably commenced. At the present time, they have no little claim to be considered victorious all along the line. I am old enough to recollect the small beginnings of the Tractarian party; and I am amazed when I consider the present position of their heirs. Their little leaven has leavened, if not the whole, yet a very large lump of the Anglican Church; which is now pretty much of a preparatory school for Papistry. So that it really behoves Englishmen (who, as I have been informed by high authority, are all legally, members of the State Church, if they profess to belong to no other sect) to wake up to what that powerful organisation is about, and whither it is tending. On this point, the writings [345] of Dr. Newman, while he still remained within the Anglican fold, are a vast store of the best and the most authoritative information. His doctrines on Ecclesiastical miracles and on Development are the corner-stones of the Tractarian fabric. He believed that his arguments led either Romeward, or to what ecclesiastics call "Infidelity," and I call Agnosticism. I believe that he was quite right in this conviction; but while he chooses the one alternative, I choose the other; as he rejects Protestantism on the ground of its incompatibility with history, so, *a fortiori,* I conceive that Romanism ought to be rejected; and that an impartial consideration of the evidence must refuse the authority of Jesus to anything more than the Nazarenism of James and Peter and John. And let it not be supposed that this is a mere "infidel" perversion of the facts. No one has more openly and clearly admitted the possibility that they may be fairly interpreted in this way than Dr. Newman. If, he says, there are texts which seem to show that Jesus contemplated the evangelisation of the heathen:

". . . Did not the Apostles hear our Lord? and what was *their* impression from what they heard? Is it not certain that the Apostles did not gather this truth from His teaching?" (Tract 85, p. 63).

"He said, 'Preach the Gospel to every creature.' These words *need* have only meant 'Bring all men to Christianity through Judaism.' Make them Jews, that they may enjoy Christ's privileges, which are lodged in Judaism; teach them those [346] rites and ceremonies, circumcision and the like, which hitherto have been dead ordinances, and now are living: and so the Apostles seem to have understood them" (*ibid.* p. 65).

So far as Nazarenism differentiated itself from contemporary orthodox

Judaism, it seems to have tended towards a revival of the ethical and religious spirit of the prophetic age, accompanied by the belief in Jesus as the Messiah, and by various accretions which had grown round Judaism subsequently to the exile. To these belong the doctrines of the Resurrection, of the Last Judgment, of Heaven and Hell; of the hierarchy of good angels; of Satan and the hierarchy of evil spirits. And there is very strong ground for believing that all these doctrines, at least in the shapes in which they were held by the post-exilic Jews, were derived from Persian and Babylonian[17] sources, and are essentially of heathen origin.

How far Jesus positively sanctioned all these indrainings of circumjacent Paganism into Judaism; how far any one has a right to declare, that the refusal to accept one or other of these doctrines, as ascertained verities, comes to the same thing as contradicting Jesus, it appears to [347] me not easy to say. But it is hardly less difficult to conceive that he could have distinctly negatived any of them; and, more especially, that demonology which has been accepted by the Christian Churches, in every age and under all their mutual antagonisms. But, I repeat my conviction that, whether Jesus sanctioned the demonology of his time and nation or not, it is doomed. The future of Christianity, as a dogmatic system and apart from the old Israelitish ethics which it has appropriated and developed, lies in the answer which mankind will eventually give to the question, whether they are prepared to believe such stories as the Gadarene and the pneumatological hypotheses which go with it, or not. My belief is they will decline to do anything of the sort, whenever and wherever their minds have been disciplined by science. And that discipline must, and will, at once follow and lead the footsteps of advancing civilisation.

The preceding pages were written before I became acquainted with the contents of the May number of the "Nineteenth Century," wherein I discover many things which are decidedly not to my advantage. It would appear that "evasion" is my chief resource, "incapacity for strict argument" and "rottenness of ratiocination" my main mental characteristics, and that it is "barely credible" that a statement which I profess to [348] make of my own knowledge is true. All which things I notice, merely to illustrate the great truth, forced on me by long experience, that it is only from those who enjoy the blessing of a firm hold of the Christian faith that such manifestations of

meekness, patience, and charity are to be expected.

I had imagined that no one who had read my preceding papers, could entertain a doubt as to my position in respect of the main issue, as it has been stated and restated by my opponent:

"an Agnosticism which knows nothing of the relation of man to God must not only refuse belief to our Lord's most undoubted teaching, but must deny the reality of the spiritual convictions in which He lived."[18]

That is said to be "the simple question which is at issue between us," and the three testimonies to that teaching and those convictions selected are the Sermon on the Mount, the Lord's Prayer, and the Story of the Passion.

My answer, reduced to its briefest form, has been: In the first place, the evidence is such that the exact nature of the teachings and the convictions of Jesus is extremely uncertain; so that what ecclesiastics are pleased to call a denial of them may be nothing of the kind. And, in the second place, if Jesus taught the demonological system involved in the Gadarene story–if a belief [349] in that system formed a part of the spiritual convictions in which he lived and died–then I, for my part, unhesitatingly refuse belief in that teaching, and deny the reality of those spiritual convictions. And I go further and add, that, exactly in so far as it can be proved that Jesus sanctioned the essentially pagan demonological theories current among the Jews of his age, exactly in so far, for me, will his authority in any matter touching the spiritual world be weakened.

With respect to the first half of my answer, I have pointed out that the Sermon on the Mount, as given in the first Gospel, is, in the opinion of the best critics, a "mosaic work" of materials derived from different sources, and I do not understand that this statement is challenged. The only other Gospel–the third–which contains something like it, makes, not only the discourse, but the circumstances under which it was delivered, very different. Now, it is one thing to say that there was something real at the bottom of the two discourses–which is quite possible; and another to affirm that we have any right to say what that something was, or to fix upon any particular phrase and declare it to be a genuine utterance. Those who pursue theology as a science, and bring to the study an adequate

knowledge of the ways of ancient historians, will find no difficulty in providing illustrations of my meaning. I may supply [350] one which has come within range of my own limited vision.

In Josephus's "History of the Wars of the Jews" (chap. xix.), that writer reports a speech which he says Herod made at the opening of a war with the Arabians. It is in the first person, and would naturally be supposed by the reader to be intended for a true version of what Herod said. In the "Antiquities," written some seventeen years later, the same writer gives another report, also in the first person, of Herod's speech on the same occasion. This second oration is twice as long as the first and, though the general tenor of the two speeches is pretty much the same, there is hardly any verbal identity, and a good deal of matter is introduced into the one, which is absent from the other. Josephus prided himself on his accuracy; people whose fathers might have heard Herod's oration were his contemporaries; and yet his historical sense is so curiously undeveloped that he can, quite innocently, perpetrate an obvious literary fabrication; for one of the two accounts must be incorrect. Now, if I am asked whether I believe that Herod made some particular statement on this occasion; whether, for example, he uttered the pious aphorism, "Where God is, there is both multitude and courage," which is given in the "Antiquities," but not in the "Wars," I am compelled to say I do not know. One of the two reports must be erroneous, possibly both are: at [351] any rate, I cannot tell how much of either is true. And, if some fervent admirer of the Idumean should build up a theory of Herod's piety upon Josephus's evidence that he propounded the aphorism, is it a "mere evasion" to say, in reply, that the evidence that he did utter it is worthless?

It appears again that, adopting the tactics of Conachar when brought face to face with Hal o' the Wynd, I have been trying to get my simple-minded adversary to follow me on a wild-goose chase through the early history of Christianity, in the hope of escaping impending defeat on the main issue. But I may be permitted to point out that there is an alternative hypothesis which equally fits the facts; and that, after all, there may have been method in the madness of my supposed panic.

For suppose it to be established that Gentile Christianity was a totally

different thing from the Nazarenism of Jesus and his immediate disciples; suppose it to be demonstrable that, as early as the sixth decade of our era at least, there were violent divergencies of opinion among the followers of Jesus; suppose it to be hardly doubtful that the Gospels and the Acts took their present shapes under the influence of those divergencies; suppose that their authors, and those through whose hands they passed, had notions of historical veracity not more eccentric than those which Josephus [352] occasionally displays: surely the chances that the Gospels are altogether trustworthy records of the teachings of Jesus become very slender. And, since the whole of the case of the other side is based on the supposition that they are accurate records (especially of speeches, about which ancient historians are so curiously loose), I really do venture to submit that this part of my argument bears very seriously on the main issue; and, as ratiocination, is sound to the core.

Again, when I passed by the topic of the speeches of Jesus on the Cross, it appears that I could have had no other motive than the dictates of my native evasiveness. An ecclesiastical dignitary may have respectable reasons for declining a fencing match "in sight of Gethsemane and Calvary"; but an ecclesiastical "Infidel"! Never. It is obviously impossible that, in the belief that "the greater includes the less," I, having declared the Gospel evidence in general, as to the sayings of Jesus, to be of questionable value, thought it needless to select for illustration of my views, those particular instances which were likely to be most offensive to persons of another way of thinking. But any supposition that may have been entertained that the old familiar tones of the ecclesiastical war-drum will tempt me to engage in such needless discussion had better be renounced. I shall do nothing of the kind. Let it suffice that I ask my readers to turn to the twenty-third [353] chapter of Luke (revised version), verse thirty-four, and he will find in the margin

"Some ancient authorities omit: And Jesus said 'Father, forgive them, for they know not what they do.'"

So that, even as late as the fourth century, there were ancient authorities, indeed some of the most ancient and weightiest, who either did not know of this utterance, so often quoted as characteristic of Jesus, or did not believe it had been uttered.

Many years ago, I received an anonymous letter, which abused me heartily for my want of moral courage in not speaking out. I thought that one of the oddest charges an anonymous letter-writer could bring. But I am not sure that the plentiful sowing of the pages of the article with which I am dealing with accusations of evasion, may not seem odder to those who consider that the main strength of the answers with which I have been favoured (in this review and elsewhere) is devoted, not to anything in the text of my first paper, but to a note which occurs at p. 212. In this I say:

"Dr. Wace tells us: 'It may be asked how far we can rely on the accounts we possess of our Lord's teaching on these subjects.' And he seems to think the question appropriately answered by the assertion that it 'ought to be regarded as settled by M. Renan's practical surrender of the adverse case.'"

I requested Dr. Wace to point out the passages of M. Renan's works in which as he affirms, this [354] "practical surrender" (not merely as to the age and authorship of the Gospels, be it observed, but as to their historical value) is made, and he has been so good as to do so. Now let us consider the parts of Dr. Wace's citation from Renan which are relevant to the issue:–

"The author of this Gospel [Luke] is certainly the same as the author of the Acts of the Apostles. Now the author of the Acts seems to be a companion of St. Paul–a character which accords completely with St. Luke. I know that more than one objection may be opposed to this reasoning: but one thing at all events, is beyond doubt, namely, that the author of the third Gospel and of the Acts is a man who belonged to the second apostolic generation; and this suffices for our purpose."

This is a curious "practical surrender of the adverse case." M. Renan thinks that there is no doubt that the author of the third Gospel is the author of the Acts–a conclusion in which I suppose critics generally agree. He goes on to remark that this person *seems* to be a companion of St. Paul, and adds that Luke was a companion of St. Paul. Then, somewhat needlessly, M. Renan points out that there is more than one objection to jumping, from such data as these, to the conclusion that "Luke" is the writer of the third Gospel. And, finally, M. Renan is content to reduce that which is "beyond doubt" to the fact that the author of the two books is a man of the second apostolic generation. Well, it seems to me that I could agree with all that M. Renan [355] considers "beyond doubt" here, without surrendering anything, either "practically" or theoretically.

Dr. Wace ("Nineteenth Century," March, p. 363) states that he derives the above citation from the preface to the 15th edition of the "Vie de Jésus." My copy of "Les Evangiles," dated 1877, contains a list of Renan's "Œuvres Complètes," at the head of which I find "Vie de Jésus," 15^{e} édition. It is, therefore, a later work than the edition of the "Vie de Jésus" which Dr. Wace quotes. Now "Les Evangiles," as its name implies, treats fully of the questions respecting the date and authorship of the Gospels; and any one who desired, not merely to use M, Renan's expressions for controversial purposes, but to give a fair account of his views in their full significance, would, I think, refer to the later source.

If this course had been taken, Dr. Wace might have found some as decided expressions of opinion, in favour of Luke's authorship of the third Gospel, as he has discovered in "The Apostles." I mention this circumstance, because I desire to point out that, taking even the strongest of Renan's statements, I am still at a loss to see how it justifies that large-sounding phrase, "practical surrender of the adverse case." For, on p. 438 of "Les Evangiles," Renan speaks of the way in which Luke's "excellent intentions" have led him to torture history in the Acts; he declares Luke [356] to be the founder of that "eternal fiction which is called ecclesiastical history"; and, on the preceding page, he talks of the "myth" of the Ascension–with its "*mise en scène voulue.*" At p. 435, I find "Luc, ou l'auteur quel qu'il soit du troisième Evangile"; at p. 280, the accounts of the Passion, the death and the resurrection of Jesus, are said to be "peu historiques"; at p. 283, "La valeur historique du troisième Evangile est sûrement moindre que celles des deux premiers." A Pyrrhic sort of victory for orthodoxy, this "surrender"! And, all the while, the scientific student of theology knows that, the more reason there may be to believe that Luke was the companion of Paul, the more doubtful becomes his credibility, if he really wrote the Acts. For, in that case, he could not fail to have been acquainted with Paul's account of the Jerusalem conference, and he must have consciously misrepresented it.

We may next turn to the essential part of Dr. Wace's citation ("Nineteenth Century," p. 365) touching the first Gospel:–

"St. Matthew evidently deserves peculiar confidence for the discourses. Here are the 'oracles'–the very notes taken while the memory of the instruction of Jesus was living and definite."

M. Renan here expresses the very general Opinion as to the existence of a collection of "logia," having a different origin from the text [357] in which they are embedded, in Matthew. "Notes" are somewhat suggestive of a shorthand writer, but the suggestion is unintentional, for M. Renan assumes that these "notes" were taken, not at the time of the delivery of the "logia" but subsequently, while (as he assumes) the memory of them was living and definite; so that, in this very citation, M. Renan leaves open the question of the general historical value of the first Gospel; while it is obvious that the accuracy of "notes" taken, not at the time of delivery, but from memory, is a matter about which more than one opinion may be fairly held. Moreover, Renan expressly calls attention to the difficulty of distinguishing the authentic "logia" from later additions of the same kind ("Les Evangiles," p. 201). The fact is, there is no contradiction here to that opinion about the first Gospel which is expressed in "Les Evangiles" (p. 175).

The text of the so-called Matthew supposes the pre-existence of that of Mark, and does little more than complete it. He completes it in two fashions–first, by the insertion of those long discourses which gave their chief value to the Hebrew Gospels; then by adding traditions of a more modern formation, results of successive developments of the legend, and to which the Christian consciousness already attached infinite value.

M. Renan goes on to suggest that besides "Mark," "pseudo-Matthew" used an Aramaic version of the Gospel, originally set forth in that [358] dialect. Finally, as to the second Gospel ("Nineteenth Century," p. 365):–

"He [Mark] is full of minute observations, proceeding, beyond doubt, from an eye-witness. There is nothing to conflict with the supposition that this eye-witness . . . was the Apostle Peter himself, as Papias has it."

Let us consider this citation by the light of "Les Evangiles":–

"This work, although composed after the death of Peter, was, in a sense, the work of Peter; it represents the way in which Peter was accustomed to relate the life of Jesus" (p. 116).

M. Renan goes on to say that, as an historical document, the Gospel of Mark has a great superiority (p. 116); but Mark has a motive for omitting the

discourses, and he attaches a "puerile importance" to miracles (p. 117). The Gospel of Mark is less a legend, than a biography written with credulity (p. 118). It would be rash to say that Mark has not been interpolated and retouched (p. 120).

If any one thinks that I have not been warranted in drawing a sharp distinction between "scientific theologians" and "counsels for creeds"; or that my warning against the too ready acceptance of certain declarations as to the state of biblical criticism was needless; or that my anxiety as to the sense of the word "practical" was superfluous; let him compare the statement that M. Renan has made a "practical surrender of the [359] adverse case" with the facts just set forth. For what is the adverse case? The question, as Dr. Wace puts it, is, "It may be asked how far can we rely on the accounts we possess of our Lord's teaching on these subjects." It will be obvious that M. Renan's statements amount to an adverse answer–to a "practical" denial that any great reliance can be placed on these accounts. He does not believe that Matthew, the apostle, wrote the first Gospel; he does not profess to know who is responsible for the collection of "logia," or how many of them are authentic; though he calls the second Gospel the most historical, he points out that it is written with credulity, and may have been interpolated and retouched; and, as to the author, "quel qu'il soit," of the third Gospel, who is to "rely on the accounts" of a writer, who deserves the cavalier treatment which "Luke" meets with at M. Renan's hands?

I repeat what I have already more than once said, that the question of the age and the authorship of the Gospels has not, in my judgment, the importance which is so commonly assigned to it; for the simple reason that the reports, even of eye-witnesses, would not suffice to justify belief in a large and essential part of their contents; on the contrary, these reports would discredit the witnesses. The Gadarene miracle, for example, is so extremely improbable, that the fact of its being reported by three, even independent, authorities [360] could not justify belief in it, unless we had the clearest evidence as to their capacity as observers and as interpreters of their observations. But it is evident that the three authorities are not independent; that they have simply adopted a legend, of which there were two versions; and instead of their proving its truth, it suggests their superstitious credulity: so that if "Matthew," "Mark," and "Luke" are really

responsible for the Gospels, it is not the better for the Gadarene story, but the worse for them.

A wonderful amount of controversial capital has been made out of my assertion in the note to which I have referred, as an *obiter dictum* of no consequence to my argument, that if Renan's work[19] were non-extant, the main results of biblical criticism, as set forth in the works of Strauss, Baur, Reuss, and Volkmar, for example, would not be sensibly affected. I thought I had explained it satisfactorily already, but it seems that my explanation has only exhibited still more of my native perversity, so I ask for one more chance.

In the course of the historical development of any branch of science, what is universally observed is this: that the men who make epochs, and are the real architects of the fabric of exact knowledge, are those who introduce fruitful ideas or [361] methods. As a rule, the man who does this pushes his idea, or his method, too far; or, if he does not, his school is sure to do so; and those who follow have to reduce his work to its proper value, and assign it its place in the whole. Not unfrequently, they, in their turn, overdo the critical process, and, in trying to eliminate error, throw away truth.

Thus, as I said, Linnæus, Buffon, Cuvier, Lamarck, really "set forth the results" of a developing science, although they often heartily contradict one another. Notwithstanding this circumstance, modern classificatory method and nomenclature have largely grown out of the work of Linnæus; the modern conception of biology, as a science, and of its relation to climatology, geography, and geology, are, as largely, rooted in the results of the labours of Buffon; comparative anatomy and palæontology owe a vast debt to Cuvier's results; while invertebrate zoology and the revival of the idea of evolution are intimately dependent on the results of the work of Lamarck. In other words, the main results of biology up to the early years of this century are to be found in, or spring out of, the works of these men.

So, if I mistake not, Strauss, if he did not originate the idea of taking the mythopœic faculty into account in the development of the Gospel narratives, and though he may have exaggerated the influence of that faculty, obliged scientific [362] theology, hereafter, to take that element into

serious consideration; so Baur, in giving prominence to the cardinal fact of the divergence of the Nazarene and Pauline tendencies in the primitive Church; so Reuss, in setting a marvellous example of the cool and dispassionate application of the principles of scientific criticism over the whole field of Scripture; so Volkmar, in his clear and forcible statement of the Nazarene limitations of Jesus, contributed results of permanent value in scientific theology. I took these names as they occurred to me. Undoubtedly, I might have advantageously added to them; perhaps, I might have made a better selection. But it really is absurd to try to make out that I did not know that these writers widely disagree; and I believe that no scientific theologian will deny that, in principle, what I have said is perfectly correct. Ecclesiastical advocates of course, cannot be expected to take this view of the matter. To them, these mere seekers after truth, in so far as their results are unfavourable to the creed the clerics have to support, are more or less "infidels," or favourers of "infidelity"; and the only thing they care to see, or probably can see, is the fact that, in a great many matters, the truth-seekers differ from one another, and therefore can easily be exhibited to the public, as if they did nothing else; as if any one who referred to their having, each and all, contributed his share to the results [363] of theological science, was merely showing his ignorance; and as if a charge of inconsistency could be based on the fact that he himself often disagrees with what they say. I have never lent a shadow of foundation to the assumption that I am a follower of either Strauss, or Baur, or Reuss, or Volkmar, or Renan; my debt to these eminent men–so far my superiors in theological knowledge–is, indeed, great; yet it is not for their opinions, but for those I have been able to form for myself, by their help.

In *Agnosticism: a Rejoinder* (p. 266), I have referred to the difficulties under which those professors of the science of theology, whose tenure of their posts depends on the results of their investigations, must labour; and, in a note, I add–

"Imagine that all our chairs of Astronomy had been founded in the fourteenth century, and that their incumbents were bound to sign Ptolemaic articles. In that case, with every respect for the efforts of persons thus hampered to attain and expound the truth, I think men of common sense would go elsewhere to learn astronomy."

I did not write this paragraph without a knowledge that its sense would be

open to the kind of perversion which it has suffered; but, if that was clear, the necessity for the statement was still clearer. It is my deliberate opinion: I reiterate it; and I say that, in my judgment, it is extremely inexpedient that any subject which calls itself a science should be entrusted to teachers who are [364] debarred from freely following out scientific methods to their legitimate conclusions, whatever those conclusions may be. If I may borrow a phrase paraded at the Church Congress, I think it "ought to be unpleasant" for any man of science to find himself in the position of such a teacher.

Human nature is not altered by seating it in a professorial chair, even of theology. I have very little doubt that if, in the year 1859, the tenure of my office had depended upon my adherence to the doctrines of Cuvier, the objections to them set forth in the "Origin of Species" would have had a halo of gravity about them that, being free to teach what I pleased, I failed to discover. And, in making that statement, it does not appear to me that I am confessing that I should have been debarred by "selfish interests" from making candid inquiry, or that I should have been biassed by "sordid motives!" I hope that even such a fragment of moral sense as may remain in an ecclesiastical "infidel" might have got me through the difficulty; but it would be unworthy to deny, or disguise, the fact that a very serious difficulty must have been created for me by the nature of my tenure. And let it be observed that the temptation, in my case, would have been far slighter than in that of a professor of theology; whatever biological doctrine I had repudiated, nobody I cared for would have thought the worse of me for so doing. No scientific journals would [365] have howled me down, as the religious newspapers howled down my too honest friend, the late Bishop of Natal; nor would my colleagues of the Royal Society have turned their backs upon me, as his episcopal colleagues boycotted him.

I say these facts are obvious, and that it is wholesome and needful that they should be stated. It is in the interests of theology, if it be a science, and it is in the interests of those teachers of theology who desire to be something better than counsel for creeds, that it should be taken to heart. The seeker after theological truth and that only, will no more suppose that I have insulted him, than the prisoner who works in fetters will try to pick a quarrel with me, if I suggest that he would get on better if the fetters were knocked

off; unless indeed, as it is said does happen in the course of long captivities, that the victim at length ceases to feel the weight of his chains, or even takes to hugging them, as if they were honourable ornaments.[20]

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[1] The substance of a paragraph which precedes this has been transferred to the Prologue.

[2] I confess that, long ago, I once or twice made this mistake; even to the waste of a capital 'U.' 1893.

[3] "Let us maintain, before we have proved. This seeming paradox is the secret of happiness" (Dr. Newman: Tract 85, p. 85).

[4] Dr. Newman, *Essay on Development,* p. 357.

[5] It is by no means to be assumed that "spiritual" and "corporeal" are exact equivalents of "immaterial" and "material" in the minds of ancient speculators on these topics. The "spiritual body" of the risen dead (1 Cor. xv.) is not the "natural" "flesh and blood" body. Paul does not teach the resurrection of the body in the ordinary sense of the word "body"; a fact, often overlooked, but pregnant with many consequences.

[6] Tertullian (*Apolog. adv. Gentes,* cap. xxiii.) thus challenges the Roman authorities: let them bring a possessed person into the presence of a Christian before their tribunal; and if the demon does not confess himself to be such, on the order of the Christian, let the Christian be executed out of hand.

[7] See the expression of orthodox opinion upon the "accommodation" subterfuge already cited above, p. 217. ["Agnosticism"]

[8] I quote the first edition (1843). A second edition appeared in 1870. Tract 85 of the *Tracts for the Times* should be read with this *Essay.* If I were called upon to compile a Primer of "Infidelity," I think I should save myself trouble by making a selection from these works, and from the *Essay on Development* by the same author.

[9] Yet, when it suits his purpose, as in the Introduction to the *Essay on Development,* Dr. Newman can demand strict evidence in religious questions as sharply as any "infidel author"; and he can even profess to yield to its force (*Essay on Miracles,* 1870; note, p. 391).

[10] Compare Tract 85, p. 110; "I am persuaded that were men but consistent who oppose the Church doctrines as being unscriptural, they would vindicate the Jews for rejecting the Gospel."

[11] **According to Dr. Newman, "This prayer [that of Bishop Alexander, who begged God to 'take Arius away'] is said to have been offered about 3 P.M. on the Saturday; that same evening Arius was in the great square of Constantine, when he was suddenly seized with indisposition" (p. clxx). The "infidel" Gibbon seems to have dared to suggest that "an option between poison and miracle" is presented by this case; and, it must be admitted, that, if the Bishop had been within the reach of a modern police magistrate, things might have gone hardly with him. Modern "Infidels," possessed of a slight knowledge of chemistry, are not unlikely, with no less audacity, to suggest an "option between fire-damp and miracle" in seeking for the cause of the fiery outburst at Jerusalem.**

[12] **A writer in a spiritualist journal takes me roundly to task for venturing to doubt the historical and literal truth of the Gadarene story. The following passage in his letter is worth quotation: "Now to the materialistic and scientific mind, to the uninitiated in spiritual verities, certainly this story of the Gadarene or Gergesene swine presents insurmountable difficulties; it seems grotesque and nonsensical. To the experienced, trained, and cultivated Spiritualist this miracle is, as I am prepared to show, one of the most instructive, the most profoundly useful and the most beneficent which Jesus ever wrought in the whole course of His pilgrimage of redemption on earth." Just so. And the first page of this same journal presents the following advertisement, among others of the same kidney:–**

"To Wealthy Spiritualists.–A Lady Medium of tried power wishes to meet with an elderly gentleman who would be willing to give her a comfortable home and maintenance in Exchange for her Spiritualistic services, as her guides consider her health is too delicate for public sittings: London preferred.–Address, 'Mary,' Office of *Light.*"

Are we going back to the days of the Judges, when wealthy Micah set up his private ephod, teraphim, and Levite?

[13] **Consider Tertullian's "sister" ("hodie apud nos"), who conversed with angels, saw and heard mysteries, knew men's thoughts, and prescribed medicine for their bodies (*De Anima,* cap. 9). Tertullian tells us that this woman saw the soul as corporeal, and described its colour and shape. The "infidel" will probably be unable to refrain from insulting the memory of the ecstatic saint by the remark, that Tertullian's known views about the corporeality of the soul may have had something to do with the remarkable perceptive powers of the Montanist medium, in whose revelations of the spiritual world he took such profound interest.**

[14] **See the New York *World* for Sunday, 21st October, 1888 and the *Report of the Seybert Commission,* Philadelphia, 1888.**

[15] **Dr. Newman's observation that the miraculous multiplication of the pieces of the true cross (with which "the whole world is filled," according to Cyril of Jerusalem; and of which some say there are enough extant to build a man-of-war) is no more wonderful than that of the loaves and fishes, is one that I do not see my way to contradict. See Essay on *Miracles,* 2d ed. p. 163.**

[16] ***An Essay on the Development of Christian Doctrine,*** **by J. H. Newman, D.D., pp. 7 and 8. (1878.)**

[17] **Dr. Newman faces this question with his customary ability. "Now, I own, I am not at all solicitous to deny that this doctrine of an apostate Angel and his hosts was gained from Babylon: it might still be Divine nevertheless. God who made the prophet's ass speak, and thereby instructed the prophet, might instruct His Church by means of heathen Babylon" (Tract 85, p. 83). There seems to be no end to the apologetic burden that Balaam's ass can carry.**

[18] ***Nineteenth Century,*** **May 1889 (p. 701).**

[19] **I trust it may not be supposed that I undervalue M. Renan's labours, or intended to speak slightingly of them.**

[20] **To-day's *Times* contains a report of a remarkable speech by Prince Bismarck, in which he tells the Reichstag that he has long given up investing in foreign stock, lest so doing should mislead his judgment in his transactions with foreign states. Does this declaration prove that the Chancellor accuses himself of being "sordid" and "selfish"; or does it not rather show that, even in dealing with himself, he remains the man of realities?**

THE HUXLEY FILE

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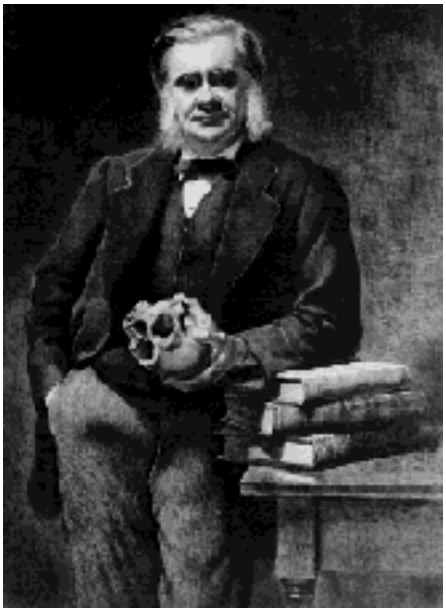

C. Blinderman & D. Joyce
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The Keepers of the Herd of Swine (1890)

Collected Essays V

[366] I had fondly hoped that Mr. Gladstone and I had come to an end of disputation, and that the hatchet of war was finally superseded by the calumet, which, as Mr. Gladstone, I believe, objects to tobacco, I was quite willing to smoke for both. But I have had, once again, to discover that the adage that whoso seeks peace will ensue it, is a somewhat hasty generalisation. The renowned warrior with whom it is my misfortune to be opposed in most things has dug up the axe and is on the war-path once more. The weapon has been wielded with all the dexterity which long practice has conferred on a past master in craft, whether of wood or state. And I have reason to believe that the simpler sort of the great tribe which he heads, imagine that my scalp is already on its way to adorn their big chief's wigwam. I am glad therefore to [367] be able to relieve any anxieties which my friends may entertain without delay. I assure them that my skull retains its normal covering, and that though, naturally, I may have felt alarmed, nothing serious has happened. My doughty adversary has merely performed a war dance, and his blows have for the most part cut the air. I regret to add, however, that by misadventure, and I am afraid I must say carelessness, he has inflicted one or two severe contusions on himself.

When the noise of approaching battle roused me from the dreams of peace which occupy my retirement, I was glad to observe (since I must fight) that the campaign was to be opened upon a new field. When the contest raged over the Pentateuchal myth of the creation, Mr. Gladstone's manifest want of acquaintance with the facts and principles involved in the discussion, no less than with the best literature on his own side of the subject, gave me the uncomfortable feeling that I had my adversary at a disadvantage. The sun of science, at my back, was in his eyes. But, on the present occasion, we are happily on an equality. History and Biblical criticism are as much, or as little, my vocation as they are that of Mr. Gladstone; the blinding from too much light, or the blindness from too little, may be presumed to be equally shared by both of us.

Mr. Gladstone takes up his new position in the country of the Gadarenes. His strategic sense [368] justly leads him to see that the authority of the teachings of the synoptic Gospels, touching the nature of the spiritual world, turns upon the acceptance, or the rejection, of the Gadarene and other like stories. As we accept, or repudiate, such histories as that of the possessed pigs, so shall we accept, or reject, the witness of the synoptics to such miraculous interventions.

It is exactly because these stories constitute the key-stone of the orthodox arch, that I originally drew attention to them; and, in spite of my longing for peace, I am truly obliged to Mr. Gladstone for compelling me to place my case before the public once more. It may be thought that this is a work of supererogation by those who are aware that my essay is the subject of attack in a work so largely circulated as the "Impregnable Rock of Holy Scripture"; and who may possibly, in their simplicity, assume that it must be truthfully set forth in that work. But the warmest admirers of Mr. Gladstone will hardly be prepared to maintain that mathematical accuracy in stating the opinions of an opponent is the

most prominent feature of his controversial method. And what follows will show that, in the present case, the desire to be fair and accurate, the existence of which I am bound to assume, has not borne as much fruit as might have been expected.

In referring to the statement of the narrators, [369] that the herd of swine perished in consequence of the entrance into them of the demons by the permission, or order, of Jesus of Nazareth, I said:

"Everything that I know of law and justice convinces me that the wanton destruction of other people's property is a misdemeanour of evil example" ("Nineteenth Century," February, 1889, p. 172).

Mr. Gladstone has not found it convenient to cite this passage; and, in view of various considerations, I dare not assume that he would assent to it, without sundry subtle modifications which, for me, might possibly rob it of its argumentative value. But, until the proposition is seriously controverted, I shall assume it to be true, and content myself with warning the reader that neither he nor I have any grounds for assuming Mr. Gladstone's concurrence. With this caution, I proceed to remark that I think it may be granted that the people whose herd of 2000 swine (more or fewer) was suddenly destroyed suffered great loss and damage. And it is quite certain that the narrators of the Gadarene story do not, in any way, refer to the point of morality and legality thus raised; as I said, they show no inkling of the moral and legal difficulties which arise.

Such being the facts of the case, I submit that for those who admit the principle laid down, the conclusion which I have drawn necessarily follows; [370] though I repeat that, since Mr. Gladstone does not explicitly admit the principle, I am far from suggesting that he is bound by its logical consequences. However, I distinctly reiterate the opinion that any one who acted in the way described in the story would, in my judgment, be guilty of "a misdemeanour of evil example." About that point I desire to leave no ambiguity whatever; and it follows that, if I believed the story, I should have no hesitation in applying this judgment to the chief actor in it.

But, if any one will do me the favour to turn to the paper in which these passages occur, he will find that a considerable part of it is devoted to the exposure of the familiar trick of the "counsel for creeds," who, when they wish to profit by the easily stirred *odium theologicum*, are careful to confuse disbelief in a narrative of a man's act, or disapproval of the acts as narrated, with disbelieving and vilipending the man himself. If I say that "according to paragraphs in several newspapers, my valued Separatist friend A. B. has houghed a lot of cattle, which he considered to be unlawfully in the possession of an Irish land-grabber; that, in my opinion, any such act is a misdemeanour of evil example; but, that I utterly disbelieve the whole story and have no doubt that it is a mere fabrication:" it really appears to me that, if any one charges me with calling A. B. an immoral misdemeanant, I should be justified in [371] using very strong language respecting either his sanity or his veracity. And, if an analogous charge has been brought in reference to the Gadarene story, there is certainly no excuse producible, on account of any lack of plain speech on my part. Surely no language can be more explicit than that which follows:

"I can discern no escape from this dilemma; either Jesus said what he is reported to have said, or he did

not. In the former case, it is inevitable that his authority on matters connected with the 'unseen world' should be roughly shaken; in the latter, the blow falls upon the authority of the synoptic Gospels" (p. 173). "The choice then lies between discrediting those who compiled the Gospel biographies and disbelieving the Master, whom they, simple souls, thought to honour by preserving such traditions of the exercise of his authority over Satan's invisible world" (p. 174). And I leave no shadow of doubt as to my own choice: "After what has been said, I do not think that any sensible man, unless he happen to be angry, will accuse me of 'contradicting the Lord and his Apostles' if I reiterate my total disbelief in the whole Gadarene story" (p. 178).

I am afraid, therefore, that Mr. Gladstone must have been exceedingly angry when he committed himself to such a statement as follows:

"So, then, after eighteen centuries of worship offered to our Lord by the most cultivated, the most developed, and the most [372] progressive portion of the human race, it has been reserved to a scientific inquirer to discover that He was no better than a law-breaker and an evil-doer . . . How, in such a matter, came the honours of originality to be reserved to our time and to Professor Huxley?" (Pp. 269, 270.)

Truly, the hatchet is hardly a weapon of precision, but would seem to have rather more the character of the boomerang, which returns to damage the reckless thrower. Doubtless such incidents are somewhat ludicrous. But they have a very serious side; and, if I rated the opinion of those who blindly follow Mr. Gladstone's leading, but not light, in these matters, much higher than the great Duke of Wellington's famous standard of minimum value, I think I might fairly beg them to reflect upon the general bearings of this particular example of his controversial method. I imagine it can hardly commend itself to their cool judgment.

After this tragi-comical ending to what an old historian calls a "robustious and rough coming on"; and after some praises of the provisions of the Mosaic law in the matter of not eating pork–in which, as pork disagrees with me and for some other reasons, I am much disposed to concur, though I do not see what they have to do with the matter in hand–comes the serious onslaught.

"Mr. Huxley, exercising his rapid judgment on the text, does not appear to have encumbered himself with the labour of inquiring what anybody else had known or said about it. He has [373] thus missed a point which might have been set up in support of his accusation against our Lord." (P. 273.)

Unhappily for my comfort, I have been much exercised in controversy during the past thirty years; and the only compensation for the loss of time and the trials of temper which it has inflicted upon me, is that I have come to regard it as a branch of the fine arts, and to take an impartial and æsthetic interest in the way in which it is conducted, even by those whose efforts are directed against myself. Now, from the purely artistic point of view (which, as we are all being told, has nothing to do with morals), I consider it an axiom, that one should never appear to doubt that the other side has performed the elementary duty of acquiring proper elementary information, unless there is demonstrative evidence to the contrary. And I think, though I admit that this may be a purely subjective appreciation, that (unless you are quite certain) there is a "want of finish," as a great master of disputation once put it, about the suggestion that your

opponent has missed a point on his own side. Because it may happen that he has not missed it at all, but only thought it unworthy of serious notice. And if he proves that, the suggestion looks foolish.

Merely noting the careful repetition of a charge, the absurdity of which has been sufficiently exposed above, I now ask my readers to accompany me on a little voyage of discovery in search of [374] the side on which the rapid judgment and the ignorance of the literature of the subject lie. I think I may promise them very little trouble, and a good deal of entertainment.

Mr. Gladstone is of opinion that the Gadarene swinefolk were "Hebrews bound by the Mosaic law" (p. 274); and he conceives that it has not occurred to me to learn what may be said in favour of and against this view. He tells us that

"Some commentators have alleged the authority of Josephus for stating that Gadara was a city of Greeks rather than of Jews, from whence it might be inferred that to keep swine was innocent and lawful." (P. 273.)

Mr. Gladstone then goes on to inform his readers that in his painstaking search after truth he has submitted to the labour of personally examining the writings of Josephus. Moreover, in a note, he positively exhibits an acquaintance, in addition, with the works of Bishop Wordsworth and of Archbishop Trench; and even shows that he has read Hudson's commentary on Josephus. And yet people say that our Biblical critics do not equal the Germans in research! But Mr. Gladstone's citation of Cuvier and Sir John Herschel about the Creation myth, and his ignorance of all the best modern writings on his own side, produced a great impression on my mind. I have had the audacity to suspect that his acquaintance with what has been done in Biblical [375] history might stand at no higher level than his information about the natural sciences. However unwillingly, I have felt bound to consider the possibility that Mr. Gladstone's labours in this matter may have carried him no further than Josephus and the worthy, but somewhat antique, episcopal and other authorities to whom he refers; that even his reading of Josephus may have been of the most cursory nature, directed not to the understanding of his author, but to the discovery of useful controversial matter; and that, in view of the not inconsiderable misrepresentation of my statements to which I have drawn attention, it might be that Mr. Gladstone's exposition of the evidence of Josephus was not more trustworthy. I proceed to show that my previsions have been fully justified. I doubt if controversial literature contains anything more *piquant* than the story I have to unfold.

That I should be reproved for rapidity of judgment is very just: however quaint the situation of Mr. Gladstone, as the reprover, may seem to people blessed with a sense of humour. But it is a quality, the defects of which have been painfully obvious to me all my life; and I try to keep my Pegasus–at best, a poor Shetland variety of that species of quadruped–at a respectable jog-trot, by loading him heavily with bales of reading. Those who took the trouble to study my paper in good faith and not for mere controversial purposes, [376] have a right to know, that something more than a hasty glimpse of two or three passages of Josephus (even with as many episcopal works thrown in) lay at the back of the few paragraphs I devoted to the Gadarene story. I proceed to set forth, as briefly as I can, some results of that preparatory work. My artistic principles do not permit me, at present, to express a doubt that Mr. Gladstone was acquainted with the facts I am about to mention when he undertook to write. But, if he

did know them, then both what he has said and what he has not said, his assertions and his omissions alike, will require a paragraph to themselves.

The common consent of the synoptic Gospels affirms that the miraculous transference of devils from a man, or men, to sundry pigs, took place somewhere on the eastern shore of the Lake of Tiberias; "on the other side of the sea over against Galilee," the western shore being, without doubt, included in the latter province. But there is no such concord when we come to the name of the part of the eastern shore, on which, according to the story, Jesus and his disciples landed. In the revised version, Matthew calls it the "country of the Gadarenes:" Luke and Mark have "Gerasenes." In sundry very ancient manuscripts "Gergesenes" occurs.

The existence of any place called Gergesa, however, is declared by the weightiest authorities [377] whom I have consulted to be very questionable; and no such town is mentioned in the list of the cities of the Decapolis, in the territory of which (as it would seem from Mark v. 20) the transaction was supposed to take place. About Gerasa, on the other hand, there hangs no such doubt. It was a large and important member of the group of the Decapolitan cities. But Gerasa is more than thirty miles distant from the nearest part of the Lake of Tiberias, while the city mentioned in the narrative could not have been very far off the scene of the event. However, as Gerasa was a very important Hellenic city, not much more than a score of miles from Gadara, it is easily imaginable that a locality which was part of Decapolitan territory may have been spoken of as belonging to one of the two cities, when it really appertained to the other. After weighing all the arguments, no doubt remains on my mind that "Gadarene" is the proper reading. At the period under consideration, Gadara appears to have been a good-sized fortified town, about two miles in circumference. It was a place of considerable strategic importance, inasmuch as it lay on a high ridge at the point of intersection of the roads from Tiberias, Scythopolis, Damascus, and Gerasa. Three miles north from it, where the Tiberias road descended into the valley of the Hieromices, lay the famous hot springs and the fashionable baths of Amatha. On the north-east side, the remains of the extensive [378] necropolis of Gadara are still to be seen. Innumerable sepulchral chambers are excavated in the limestone cliffs, and many of them still contain sarcophaguses of basalt; while not a few are converted into dwellings by the inhabitants of the present village of Um Keis. The distance of Gadara from the south-eastern shore of the Lake of Tiberias is less than seven miles. The nearest of the other cities of the Decapolis, to the north, is Hippos, which also lay some seven miles off, in the south-eastern corner of the shore of the lake. In accordance with the ancient Hellenic practice, that each city should be surrounded by a certain amount of territory amenable to its jurisdiction[1] and on other grounds, it may be taken for certain that the intermediate country was divided between Gadara and Hippos; and that the citizens of Gadara had free access to a port on the lake. Hence the title of "country of the Gadarenes" applied to the locality of the porcine catastrophe becomes easily intelligible. The swine may well be imagined to have been feeding (as they do now in the adjacent region) on the hillsides, which slope somewhat steeply down to the lake from the northern boundary wall of the valley of the Hieromices (*Nahr Yarmuk*), about half-way between the city [379] and the shore, and doubtless lay well within the territory of the *polis* of Gadara.

The proof that Gadara was, to all intents and purposes, a Gentile, and not a Jewish, city is complete. The

date and the occasion of its foundation are unknown; but it certainly existed in the third century B.C. Antiochus the Great annexed it to his dominions in B.C. 198. After this, during the brief revival of Jewish autonomy, Alexander Jannæus took it; and for the first time, so far as the records go, it fell under Jewish rule.[2] From this it was rescued by Pompey (B.C. 63), who rebuilt the city and incorporated it with the province of Syria. In gratitude to the Romans for the dissolution of a hated union, the Gadarenes adopted the Pompeian era on their coinage. Gadara was a commercial centre of some importance, and therefore, it may be assumed, Jews settled in it, as they settled in almost all considerable Gentile cities. But a wholly mistaken estimate of the magnitude of the Jewish colony has been based upon the notion that Gabinius, proconsul of Syria in 57-55 B.C., seated one of the five sanhedrims in Gadara. Schürer has pointed out that what he really did was to lodge one of them in Gazara, far away on the other side of the Jordan. This is one of the many errors which have arisen out of the confusion of the names Ga*d*ara, Gazara, and Ga*b* ara.

[380] Augustus made a present of Gadara to Herod the Great, as an appanage personal to himself; and, upon Herod's death, recognising it to be a "Grecian city" like Hippos and Gaza[3] he transferred it back to its former place in the province of Syria. That Herod made no effort to judaise his temporary possession, but rather the contrary, is obvious from the fact that the coins of Gadara, while under his rule, bear the image of Augustus with the superscription [blessed]–a flying in the face of Jewish prejudices which, even he, did not dare to venture upon in Judea. And I may remark that, if my co-trustee of the British Museum had taken the trouble to visit the splendid numismatic collection under our charge, he might have seen two coins of Gadara, one of the time of Tiberius and the other of that of Titus, each bearing the effigies of the emperor on the obverse: while the personified genius of the city is on the reverse of the former. Further, the well-known works of De Saulcy and of Ekhel would have supplied the information that, from the time of Augustus to that of Gordian, the Gadarene coinage had the same thoroughly Gentile character. Curious that a city of "Hebrews bound by the Mosaic law" should tolerate such a mint!

[381] Whatever increase in population the Ghetto of Gadara may have undergone, between B.C. 4 and A. D. 66, it nowise affected the gentile and anti-judaic character of the city at the outbreak of the great war; for Josephus tells us that, immediately after the great massacre of Cæsarea, the revolted Jews "laid waste the villages of the Syrians and their neighbouring cities, Philadelphia and Sebonitis and Gerasa and Pella and Scythopolis and after them Gadara and Hippos" ("Wars," II. xviii. 1). I submit that, if Gadara had been a city of "Hebrews bound by the Mosaic law," the ravaging of their territory by their brother Jews, in revenge for the massacre of the Cæsarean Jews by the Gentile population of that place, would surely have been a somewhat unaccountable proceeding. But when we proceed a little further, to the fifth section of the chapter in which this statement occurs, the whole affair becomes intelligible enough.

"Besides this murder at Scythopolis, the other cities rose up against the Jews that were among them: those of Askelon slew two thousand five hundred, and those of Ptolemais two thousand, and put not a few into bonds; those of Tyre also put a great number to death, but kept a greater number in prison; more over, of Hippos and those of Gadara did the like, while they put to death the boldest of the Jews, but kept those of whom they were most afraid in custody; as did the rest of the cities of Syria according as they every one either hated them or were afraid of them."

Josephus is not always trustworthy, but he has [382] no conceivable motive for altering facts here; he speaks of contemporary events, in which he himself took an active part, and he characterises the cities in the way familiar to him. For Josephus, Gadara is just as much a Gentile city as Ptolemais; it was reserved for his latest commentator, either ignoring, or ignorant of, all this, to tell us that Gadara had a Hebrew population, bound by the Mosaic law.

In the face of all this evidence, most of which has been put before serious students, with full reference to the needful authorities and in a thoroughly judicial manner, by Schürer in his classical work,[4] one reads with stupefaction the statement which Mr. Gladstone has thought fit to put before the uninstructed public:

"Some commentators have alleged the authority of Josephus for stating that Gadara was a city of Greeks rather than of Jews, from whence it might be inferred that to keep swine was innocent and lawful. This is not quite the place for a critical examination of the matter; but I have examined it, and have satisfied myself that Josephus gives no reason whatever to suppose that the population of Gadara, and still less (if less may be) the population of the neighbourhood, and least of all the swine-herding or lower portion of that population, were other than Hebrews bound by the Mosaic law." (Pp. 373-4.)

Even "rapid judgment" cannot be pleaded in excuse for this surprising statement, because a "Note on the Gadarene miracle" is added (in a special appendix), in which the references are [383] given to the passages of Josephus, by the improved interpretation of which, Mr. Gladstone has thus contrived to satisfy himself of the thing which is not. One of these is "Antiquities" XVII. xiii. 4, in which section, I regret to say, I can find no mention of Gadara. In "Antiquities," XVII. xi. 4, however, there is a passage which would appear to be that which Mr. Gladstone means; and I will give it in full although I have already cited part of it:

"There were also certain of the cities which paid tribute to Arehelaus; Strato's tower, and Sebaste, with Joppa and Jerusalem; for, as to Gaza, Gadara, and Hippos, they were Grecian cities, which Cæsar separated from his government, and added them to the province of Syria."

That is to say, Augustus simply restored the state of things which existed before he gave Gadara, then certainly a Gentile city, lying outside Judea, to Herod as a mark of great personal favour. Yet Mr. Gladstone can gravely tell those who are not in a position to check his statements:

"The sense seems to be, not that these cities were inhabited by a Greek population, but that they had politically been taken out of Judea and added to Syria, which I presume was classified as simply Hellenic, a portion of the great Greek empire erected by Alexander." (Pp. 295-6.)

Mr. Gladstone's next reference is to the "Wars," III. vii. 1:

"So Vespasian marched to the city Gadara, and took it upon the first onset, because he found it destitute of a considerable [384] number of men grown up fit for war. He then came into it, and slew all the youth, the Romans having no mercy on any age whatsoever; and this was done out of the hatred they bore the nation, and because of

the iniquity they had been guilty of in the affair of Cestius."

Obviously, then, Gadara was an ultra-Jewish city. Q.E.D. But a student trained in the use of weapons of precision, rather than in that of rhetorical tomahawks, has had many and painful warnings to look well about him, before trusting an argument to the mercies of a passage, the context of which he has not carefully considered. If Mr. Gladstone had not been too much in a hurry to turn his imaginary prize to account–if he had paused just to look at the preceding chapter of Josephus–he would have discovered that his much haste meant very little speed. He would have found ("Wars," III vi. 2) that Vespasian marched from his base, the port of Ptolemais (Acre), on the shores of the Mediterranean, into Galilee; and, having dealt with the so-called "Gadara," was minded to finish with Jotapata, a strong place about fourteen miles south-east of Ptolemais, into which Josephus, who at first had fled to Tiberias, eventually threw himself–Vespasian arriving before Jotapata "the very next day." Now, if any one will take a decent map of Ancient Palestine in hand, he will see that Jotapata, as I have said, lies about fourteen miles in a straight line east-south-east of Ptolemais, [385] while a certain town, "Gabara" (which was also held by the Jews), is situated, about the same distance, to the east of that port. Nothing can be more obvious than that Vespasian, wishing to advance from Ptolemais into Galilee, could not afford to leave these strongholds in the possession of the enemy; and, as Gabara would lie on his left flank when he moved to Jotapata, he took that city, whence his communications with his base could easily be threatened, first. It might really have been fair evidence of demoniac possession, if the best general of Rome had marched forty odd miles, as the crow flies, through hostile Galilee, to take a city (which, moreover, had just tried to abolish its Jewish population) on the other side of the Jordan; and then marched back again to a place fourteen miles off his starting-point.[5] One would think that the most careless of readers must be startled by this incongruity into inquiring whether there might not be something wrong with the text; and, if he had done so, he would have easily discovered that since the time of Reland, a century and a half ago, careful scholars have read Ga*b* ara for Ga*d* ara.[6]

Once more, I venture to point out that training [386] in the use of the weapons of precision of science may have its value in historical studies, if only in preventing the occurrence of droll blunders in geography.

In the third citation ("Wars," IV. vii.) Josephus tells us that Vespasian marched against "Gadara," which he calls the metropolis of Peræa (it was possibly the seat of a common festival of the Decapolitan cities), and entered it, without opposition, the wealthy and powerful citizens having opened negotiations with him without the knowledge of an opposite party, who, "as being inferior in number to their enemies, who were within the city, and seeing the Romans very near the city," resolved to fly. Before doing so, however, they, after a fashion unfortunately too common among the Zealots, murdered and shockingly mutilated Dolesus, a man of the first rank, who had promoted the embassy to Vespasian; and then "ran out of the city." Hereupon, "the people of Gadara" (surely not this time "Hebrews bound by the Mosaic law") received Vespasian with joyful acclamations, voluntarily pulled down their wall, so that the city could not in future be used as a fortress by the Jews, and accepted a Roman garrison for their future protection. Granting that this Gadara really is the city of the Gadarenes, the reference, without citation, to the passage, in support of Mr. Gladstone's contention seems rather remarkable. Taken in conjunction

[387] with the shortly antecedent ravaging of the Gadarene territory by the Jews, in fact, better proof could hardly be expected of the real state of the case; namely, that the population of Gadara (and notably the wealthy and respectable part of it) was thoroughly Hellenic; though, as in Cæsarea and elsewhere among the Palestinian cities, the rabble contained a considerable body of fanatical Jews, whose reckless ferocity made them, even though a mere minority of the population, a standing danger to the city.

Thus Mr. Gladstone's conclusion from his study of Josephus, that the population of Gadara were "Hebrews bound by the Mosaic law," turns out to depend upon nothing better than a marvellously complete misinterpretation of what that author says, combined with equally marvellous geographical misunderstandings, long since exposed and rectified; while the positive evidence that Gadara, like other cities of the Decapolis, was thoroughly Hellenic in organisation, and essentially Gentile in population, is overwhelming.

And, that being the fact of the matter, patent to all who will take the trouble to enquire about what has been said about it, however obscure to those who merely talk of so doing, the thesis that the Gadarene swineherds, or owners, were Jews violating the Mosaic law shows itself to be an empty and most unfortunate guess. But really, whether they that kept the swine were Jews, or [388] whether they were Gentiles, is a consideration which has no relevance whatever to my case. The legal provisions, which alone had authority over an inhabitant of the country of the Gadarenes, were the Gentile laws sanctioned by the Roman suzerain of the province of Syria, just as the only law, which has authority in England, is that recognised by the sovereign Legislature. Jewish communities in England may have their private code, as they doubtless had in Gadara. But an English magistrate, if called upon to enforce their peculiar laws, would dismiss the complainants from the judgment seat, let us hope with more politeness than Gallio did in a like case, but quite as firmly. Moreover, in the matter of keeping pigs, we may be quite certain that Gadarene law left everybody free to do as he pleased indeed encouraged the practice rather than otherwise. Not only was pork one of the commonest and one of the most favourite articles of Roman diet; but, to both Greeks and Romans, the pig was a sacrificial animal of high importance. Sucking pigs played an important part in Hellenic purificatory rites; and everybody knows the significance of the Roman suovetaurilia, depicted on so many bas-reliefs.

Under these circumstances, only the extreme need of a despairing "reconciler" drowning in a sea of adverse facts, can explain the catching at such a poor straw as the reckless guess that the [389] swineherds of the "country of the Gadarenes" were erring Jews, doing a little clandestine business on their own account. The endeavour to justify the asserted destruction of the swine by the analogy of breaking open a cask of smuggled spirits, and wasting their contents on the ground, is curiously unfortunate. Does Mr. Gladstone mean to suggest that a Frenchman landing at Dover, and coming upon a cask of smuggled brandy in the course of a stroll along the cliffs, has the right to break it open and waste its contents on the ground? Yet the party of Galileans who, according to the narrative, landed and took a walk on the Gadarene territory, were as much foreigners in the Decapolis as Frenchmen would be at Dover. Herod Antipas, their sovereign, had no jurisdiction in the Decapolis–they were strangers and aliens, with no more right to interfere with a pig-keeping Hebrew, than I have a right to interfere with an English professor of the Israelitic faith, if I see a slice of ham on his plate. According to the law of the country in which these Galilean foreigners found themselves, men might keep pigs if they pleased. If the

men who kept them were Jews, it might be permissible for the strangers to inform the religious authority acknowledged by the Jews of Gadara; but to interfere themselves, in such a matter, was a step devoid of either moral or legal justification.

Suppose a modern English Sabbatarian fanatic, [390] who believes, on the strength of his interpretation of the fourth commandment, that it is a deadly sin to work on the "Lord's Day," sees a fellow Puritan yielding to the temptation of getting in his harvest on a fine Sunday morning–is the former justified in setting fire to the latter's corn? Would not an English court of justice speedily teach him better?

In truth, the government which permits private persons, on any pretext (especially pious and patriotic pretexts), to take the law into their own hands, fails in the performance of the primary duties of all governments; while those who set the example of such acts, or who approve them, or who fail to disapprove them, are doing their best to dissolve civil society: they are compassers of illegality and fautors of immorality.

I fully understand that Mr. Gladstone may not see the matter in this light. He may possibly consider that the union of Gadara with the Decapolis, by Augustus, was a "blackguard" transaction, which deprived Hellenic Gadarene law of all moral force; and that it was quite proper for a Jewish Galilean, going back to the time when the land of the Girgashites was given to his ancestors, some 1500 years before, to act, as if the state of things which ought to obtain, in territory which traditionally, at any rate, belonged to his forefathers, did really exist. And, that being so, I can only say I do not agree with him, but leave [391] the matter to the appreciation of those of our countrymen, happily not yet the minority, who believe that the first condition of enduring liberty is obedience to the law of the land.

The end of the month drawing nigh, I thought it well to send away the manuscript of the foregoing pages yesterday, leaving open, in my own mind, the possibility of adding a succinct characterisation of Mr. Gladstone's controversial methods as illustrated therein. This morning, however, I had the pleasure of reading a speech which I think must satisfy the requirements of the most fastidious of controversial artists; and there occurs in it so concise, yet so complete, a delineation of Mr. Gladstone's way of dealing with disputed questions of another kind, that no poor effort of mine could better it as a description of the aspect which his treatment of scientific, historical, and critical questions presents to me.

"The smallest examination would have told a man of his capacity and of his experience that he was uttering the grossest exaggerations, that he was basing arguments upon the slightest hypothesis, and that his discussions only had to be critically examined by the most careless critic in order to show their intrinsic hollowness."

Those who have followed me through this paper will hardly dispute the justice of this judgment, severe as it is. But the Chief Secretary for [392] Ireland has science in the blood; and has the advantage of a natural, as well as a highly cultivated, aptitude for the use of methods of precision in investigation, and for the exact enunciation of the results thereby obtained.

[1] Thus Josephus (lib. ix.) says that his rival, Justus, persuaded the citizens of Tiberias to "set the villages that belonged to Gadara and Hippos on fire; which villages were situated on the borders of Tiberias and of the region of Scythopolis."

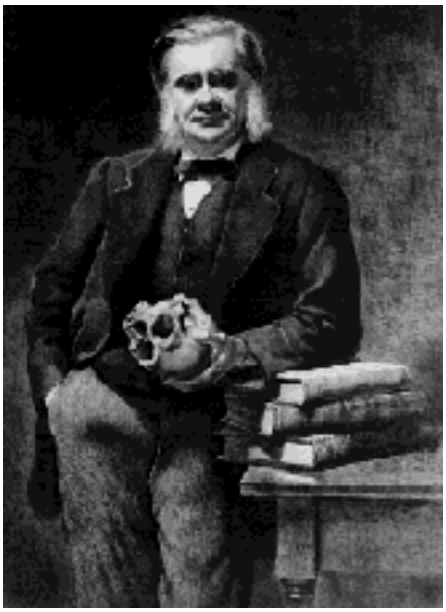
[2] It is said to have been destroyed by its captors.

[3] "But as to the Grecian cities, Gaza and Gadara and Hippos, he cut them off from the kingdom and added them to Syria."–Josephus, *Wars*, II, vi. 3. See also *Antiquities*, XVII. xi. 4.

[4] *Geshichte des jüdischen Volkes im Zeitalter Christi*, 1886-90.

[5] If William the Conqueror, after fighting the battle of Hastings, had marched to capture Chichester and then returned to assault Rye, being all the while anxious to reach London, his proceedings would not have been more eccentric than Mr. Gladstone must imagine those of Vespasian were.

[6] See Reland, Palestina (1714), t. ii, p.771. Also Robinson, *Later Biblical Researches* (1856), p. 87 *note*.



Illustrations of Mr. Gladstone's Controversial Methods

The Nineteenth Century (March 1891)

Collected Essays V

[393] The series of essays, in defence of the historical accuracy of the Jewish and Christian Scriptures, contributed by Mr. Gladstone to "Good Words," having been revised and enlarged by their author, appeared last year as a separate volume, under the somewhat defiant title of "The Impregnable Rock of Holy Scripture."

The last of these Essays, entitled "Conclusion," contains an attack, or rather several attacks, couched in language which certainly does not err upon the side of moderation or of courtesy, upon statements and opinions of mine. One of these assaults is a deliberately devised attempt, not merely to rouse the theological prejudices ingrained in the majority of Mr. Gladstone's readers, but to hold me up as a person who has endeavoured to besmirch the personal character of the object of their veneration. For Mr. Gladstone asserts that [394] I have undertaken to try "the character of our Lord" (p. 268); and he tells the many who are, as I think unfortunately, predisposed to place implicit credit in his assertions, that it has been reserved for me to discover that Jesus "was no better than a law-breaker and an evil-doer!" (p. 269).

It was extremely easy for me to prove, as I did in the pages of this Review last December, that, under the most favourable interpretation, this amazing declaration must be ascribed to extreme confusion of thought. And, by bringing an abundance of good-will to the consideration of the subject, I have now convinced myself that it is right for me to admit that a person of Mr. Gladstone's intellectual acuteness really did mistake the reprobation of the course of conduct ascribed to Jesus, in a story of which I expressly say I do not believe a word, for an attack on his character and a declaration that he was "no better than a law-breaker, and an evil-doer." At any rate, so far as I can see, this is what Mr. Gladstone wished to be believed when he wrote the following passage:–

"I must, however, in passing, make the confession that I did not state with accuracy, as I ought to have done, the precise form of the accusation. I treated it as an imputation on the action of our Lord; he replies that it is only an imputation on the narrative of three evangelists respecting Him. The difference, from his point of view, is probably material, and I therefore regret that I overlooked it."[1]

[395] Considering the gravity of the error which is here admitted, the fashion of the withdrawal appears more singular than admirable. From my "point of view"–not from Mr. Gladstone's apparently–the little discrepancy between the facts and Mr. Gladstone's carefully offensive travesty of them is "probably" (only "probably") material. However, as Mr. Gladstone concludes with an official expression of regret for his error, it is my business to return an equally official expression of gratitude for the attenuated reparation with which I am favoured.

Having cleared this specimen of Mr. Gladstone's controversial method out of the way, I may proceed to the next assault, that on a passage in an article on Agnosticism ("Nineteenth Century," February 1889), published two years ago. I there said, in referring to the Gadarene story, "Everything I know of law and justice convinces me that the wanton destruction of other people's property is a misdemeanour of evil example." On this, Mr. Gladstone, continuing his candid and urbane observations, remarks ("Impregnable Rock," p. 273) that, "Exercising his rapid judgment on the text," and "not inquiring what anybody else had known or said about it," I had missed a point in support of that "accusation against our Lord" which he has now been constrained to admit I never made.

The "point" in question is that "Gadara was a [396] city of Greeks rather than of Jews, from whence it might be inferred that to keep swine was innocent and lawful." I conceive that I have abundantly proved that Gadara answered exactly to the description here given of it; and I shall show, by and by, that Mr. Gladstone has used language which, to my mind, involves the admission that the authorities of the city were not Jews. But I have also taken a good deal of pains to show that the question thus raised is of no importance in relation to the main issue.[2] If Gadara was, as I maintain it was, a city of the Decapolis, Hellenistic in constitution and containing a predominantly Gentile population, my case is superabundantly fortified. On the other hand, if the hypothesis that Gadara was under Jewish government, which Mr. Gladstone seems sometimes to defend and sometimes to give up, were accepted, my case would be nowise weakened. At any rate, Gadara was not included within the jurisdiction of the tetrach of Galilee; if it had been, the Galileans who crossed over the lake to [397] Gadara had no official status; and they had no more civil right to punish law-breakers than any other strangers.

In my turn, however, I may remark that there is a "point" which appears to have escaped Mr. Gladstone's notice. And that is somewhat unfortunate, because his whole argument turns upon it. Mr. Gladstone assumes, as a matter of course, that pig-keeping was an offence against the "Law of Moses"; and, therefore, that Jews who kept pigs were as much liable to legal pains and penalties as Englishmen who smuggle brandy ("Impregnable Rock," p. 274).

There can be no doubt that, according to the Law, as it is defined in the Pentateuch, the pig was an "unclean" animal, and that pork was a forbidden article of diet. Moreover, since pigs are hardly likely to be kept for the mere love of those unsavoury animals, pig-owning, or swine-herding, must have been, and evidently was regarded as a suspicious and degrading occupation by strict Jews, in the first century A.D. But I should like to know on what provision of the Mosaic Law, as it is laid down in the Pentateuch, Mr. Gladstone bases the assumption, which is essential to his case, that the possession of pigs and the calling of a swineherd were actually illegal. The inquiry was put to me the other day; and, as I could not answer it, I turned up the article "Schwein" in Riehm's standard [398] "Handwörterbuch," for help out of my difficulty; but unfortunately without success. After speaking of the martyrdom which the Jews, under Antiochus Epiphanes, preferred to eating pork, the writer proceeds:–

"It may be, nevertheless, that the practice of keeping pigs may have found its way into Palestine in the Græco-Roman time, in consequence of the great increase of the non-Jewish population; yet there is no evidence of it in the New Testament; the great herd of swine, 2,000 in number, mentioned in the narrative of the possessed, was

feeding in the territory of Gadara, which belonged to the Decapolis; and the prodigal son became a swineherd with the native of a far country into which he had wandered; in neither of these cases is there reason for thinking that the possessors of these herds were Jews."[3]

Having failed in my search, so far, I took up the next work of reference at hand, Kitto's "Cyclopædia" (vol. iii. 1876). There, under "Swine," the writer, Colonel Hamilton Smith, seemed at first to give me what I wanted, as he says that swine "appear to have been repeatedly introduced and reared by the Hebrew people,[4] notwithstanding the strong prohibition in the Law of Moses (Is. 1xv. 4)." But, in the first place, [399] Isaiah's writings form no part of the "Law of Moses"; and, in the second place, the people denounced by the prophet in this passage are neither the possessors of pigs, nor swineherds, but these "which eat swine's flesh and broth of abominable things is in their vessels." And when, in despair, I turned to the provisions of the Law itself, my difficulty was not cleared up. Leviticus xi. 8 (Revised Version) says, in reference to the pig and other unclean animals: "Of their flesh ye shall not eat, and their carcasses ye shall not touch." In the revised version of Deuteronomy, xiv. 8, the words of the prohibition are identical, and a skilful refiner might possibly satisfy himself, even if he satisfied nobody else, that "carcase" means the body of a live animal as well as a dead one; and that, since swineherds could hardly avoid contact with their charges, their calling was implicitly forbidden.[5] Unfortunately, the authorised version expressly says "dead carcase"; and thus the most rabbinically minded of reconcilers might find his casuistry foiled by that great source of surprises, the "original Hebrew." That such check is at any rate possible, is clear from the fact that the legal uncleanness of some animals, as food, did not interfere with their being lawfully possessed, cared for, and sold by Jews. The [400] provisions for the ransoming of unclean beasts (Lev. xxvii. 27) and for the redemption of their sucklings (Numbers xviii. 15) sufficiently prove this. As the late Dr. Kalisch has observed in his "Commentary" on Leviticus, part ii. p. l29, note:–

"Though asses and horses, camels and dogs, were kept by the Israelites, they were, to a certain extent, associated with the notion of impurity; they might be turned to profitable account by their labour or otherwise, but in respect to food they were an abomination."

The same learned commentator (*loc. cit.* p. 88) proves that the Talmudists forbade the rearing of pigs by Jews, unconditionally and everywhere; and even included it under the same ban as the study of Greek philosophy, "since both alike were considered to lead to the desertion of the Jewish faith." It is very possible, indeed probable, that the Pharisees of the fourth decade of our first century took as strong a view of pig-keeping as did their spiritual descendants. But, for all that, it does not follow that the practice was illegal. The stricter Jews could not have despised and hated swineherds more than they did publicans; but, so far as I know, there is no provision in the Law against the practice of the calling of a tax-gatherer by a Jew. The publican was in fact very much in the position of an Irish process-server at the present day–more, rather than less, despised and hated on account of the perfect legality of his occupation. Except for certain [401] sacrificial purposes, pigs were held in such abhorrence by the ancient Egyptians, that swineherds were not permitted to enter a temple, or to intermarry with other castes; and any one who had touched a pig, even accidentally, was unclean. But these very regulations prove that pig-keeping was not illegal; it merely involved certain civil and religious disabilities. For the

Jews, dogs were typically "unclean animals;" but, when that eminently pious Hebrew, Tobit, "went forth" with the angel "the young man's dog" went "with them" (Tobit v. 16) without apparent remonstrance from the celestial guide. I really do not see how an appeal to the Law could have justified any one in drowning Tobit's dog, on the ground that his master was keeping and feeding an animal quite as "unclean" as any pig. Certainly the excellent Raguel must have failed to see the harm of dog-keeping, for we are told that, on the travellers' return homewards, "the dog went after them" (xi. 4).

Until better light than I have been able to obtain is thrown upon the subject, therefore, it is obvious that Mr. Gladstone's argumentative house has been built upon an extremely slippery quicksand; perhaps even has no foundation at all.

Yet another "point" does not seem to have occurred to Mr. Gladstone, who is so much shocked that I attach no overwhelming weight to the assertions contained in the synoptic Gospels, even [402] when all three concur. These Gospels agree in stating, in the most express, and to some extent verbally identical, terms, that the devils entered the pigs at their own request,[6] and the third Gospel (viii. 31) tells us what the motive of the demons was in asking the singular boon: "They intreated him that he would not command them to depart into the abyss." From this, it would seem that the devils thought to exchange the heavy punishment of transportation to the abyss for the lighter penalty of imprisonment in swine. And some commentators, more ingenious than respectful to the supposed chief actor in this extraordinary fable, have dwelt, with satisfaction, upon the very unpleasant quarter of an hour which the evil spirits must have had, when the headlong rush of their maddened tenements convinced them how completely they were taken in. In the whole story, there is not one solitary hint that the destruction of the pigs was intended as a punishment of their owners, or of the swineherds. On the contrary, the concurrent testimony of the three narratives is to the effect that the catastrophe was the consequence of diabolic suggestion. And, indeed, no source could [403] be more appropriate for an act of such manifest injustice and illegality.

I can but marvel that modern defenders of the faith should not be glad of any reasonable excuse for getting rid of a story which, if it had been invented by Voltaire, would have justly let loose floods of orthodox indignation.

Thus, the hypothesis, to which Mr. Gladstone so fondly clings, finds no support in the provisions of the "Law of Moses" as that law is defined in the Pentateuch; while it is wholly inconsistent with the concurrent testimony of the synoptic Gospels, to which Mr. Gladstone attaches so much weight. In my judgment, it is directly contrary to everything which profane history tells us about the constitution and the population of the city of Gadara; and it commits those who accept it to a story which, if it were true, would implicate the founder of Christianity in an illegal and inequitable act.

Such being the case, I consider myself excused from following Mr. Gladstone through all the meanderings of his late attempt to extricate himself from the maze of historical and exegetical difficulties in which he is entangled. I content myself with assuring those who, with my paper (not Mr. Gladstone's version of my arguments) in hand, consult the original authorities, that they will find full

justification for every statement I [404] have made. But in order to dispose those who cannot, or will not, take that trouble, to believe that the proverbial blindness of one that judges his own cause plays no part in inducing me to speak thus decidedly, I beg their attention to the following examination, which shall be as brief as I can make it, of the seven propositions in which Mr. Gladstone professes to give a faithful summary of my "errors."

When, in the middle of the seventeenth century, the Holy See declared that certain propositions contained in the works of Bishop Jansen were heretical, the Jansenists of Port Royal replied that, while they were ready to defer to the Papal authority about questions of faith and morals, they must be permitted to judge about questions of fact for themselves; and that, really, the condemned propositions were not to be found in Jansen's writings. As everybody knows, His Holiness and the Grand Monarque replied to this, surely not unreasonable, plea after the manner of Lord Peter in the "Tale of a Tub." It is, therefore, not without some apprehension of meeting with a similar fate, that I put in a like plea against Mr. Gladstone's Bull. The seven propositions declared to be false and condemnable, in that kindly and gentle way which so pleasantly compares with the authoritative style of the Vatican (No. 5 more particularly), may or may not be true. But they are not to be found in [405] anything I have written. And some of them diametrically contravene that which I have written. I proceed to prove my assertions.

PROP. 1. *Throughout the paper he confounds together what I had distinguished, namely, the city of Gadara and the vicinage attached to it, not as a mere pomœrium, but as a rural district.*

In my judgment, this statement is devoid of foundation. In my paper on "The Keepers of the Herd of Swine" I point out, at some length, that, "in accordance with the ancient Hellenic practice," each city of the Decapolis must have been "surrounded by a certain amount of territory amenable to its jurisdiction": and, to enforce this conclusion, I quote what Josephus says about the "villages that belonged to Gadara and Hippos." As I understand the term *pomerium* or *pomœrium*,[7] it means the space which, according to Roman custom, was kept free from buildings, immediately within and without the walls of a city; and which defined the range of the *auspicia urbana.* The conception of a *pomœrium* as a "vicinage attached to" a city, appears to be something quite novel and original. But then, to be sure, I do not know how many senses Mr. Gladstone may attach to the word "vicinage."

Whether Gadara had a *pomœrium,* in the proper technical sense, or not, is a point on which I offer no opinion. But that the city had a very [406] considerable "rural district" attached to it and notwithstanding its distinctness, amenable to the jurisdiction of the Gentile municipal authorities, is one of the main points of my case.

PROP. 2. *He more fatally confounds the local civil government and its following, including, perhaps, the whole wealthy class and those attached to it, with the ethnical character of the general population.*

Having survived confusion No. 1, which turns out not to be on my side, I am now confronted in No. 2 with a "more fatal" error–and so it is, if there be degrees of fatality; but, again, it is Mr. Gladstone's and not mine. It would appear, from this proposition (about the grammatical interpretation of which,

however, I admit there are difficulties), that Mr. Gladstone holds that the "local civil government and its following among the wealthy," were ethnically different from the "general population." On p. 348, he further admits that the "wealthy and the local governing power" were friendly to the Romans. Are we then to suppose that it was the persons of Jewish "ethnical character" who favoured the Romans, while those of Gentile "ethnical character" were opposed to them? But, if that supposition is absurd, the only alternative is that the local civil government was ethnically Gentile. This is exactly my contention.

At pp. 379 to 391 of the essay on "The Keepers of the Herd of Swine" I have fully discussed the question of the ethnical character of the general population. I have shown that, according to Josephus, who surely ought to have known, Gadara was as much a Gentile city as Ptolemais; I have proved that he includes Gadara amongst the cities "that rose up against the Jews that were amongst them," which is a pretty definite expression of his belief that the "ethnical character of the general population" was Gentile. There is no question here of Jews of the Roman party fighting with Jews of the Zealot party, as Mr. Gladstone suggests. It is the non-Jewish and anti-Jewish general population which rises up against the Jews who had settled "among them."

PROP. 3. *His one item of direct evidence as to the Gentile character of the city refers only to the former and not to the latter.*

More fatal still. But, once more, not to me. I adduce not one, but a variety of "items" in proof of the non-Judaic character of the population of Gadara: the evidence of history; that of the coinage of the city; the direct testimony of Josephus, just cited–to mention no others. I repeat, if the wealthy people and those connected with them–the "classes" and the "hangers on" of Mr. Gladstone's well-known taxonomy–were, as he appears to admit they were, Gentiles; if the "civil government" of the city was in their hands, as the coinage proves it was; what becomes of Mr. Gladstone's original proposition in "The Impregnable Rock of Scripture" that "the population of Gadara, and still less (if less may be) the population of the neighbourhood," were "Hebrews bound by the Mosaic law"? And what is the importance of estimating the precise proportion of Hebrews who may have resided, either in the city of Gadara or in its dependent territory, when, as Mr. Gladstone now seems to admit (I am careful to say "seems"), the government, and consequently the law, which ruled in that territory and defined civil right and wrong was Gentile and not Judaic? But perhaps Mr. Gladstone is prepared to maintain that the Gentile "local civil government" of a city of the Decapolis administered Jewish Law; and showed their respect for it, more particularly, by stamping their coinage with effigies of the Emperors.

In point of fact, in his haste to attribute to me errors which I have not committed, Mr. Gladstone has given away his case.

PROP. 4. *He fatally confounds the question of political party with those of nationality and of religion, and assumes that those who took the side of Rome in the factions that prevailed could not be subject to the Mosaic Law.*

It would seem that I have a feline tenacity of life; once more, a "fatal error." But Mr. Gladstone has

forgotten an excellent rule of controversy; say what is true, of course, but mind that it is decently probable. Now it is not decently probable, hardly indeed conceivable, that any one who has read Josephus, or any other historian of the Jewish war, should be unaware that there were Jews (of whom Josephus himself was one) who "Romanised" and, more or less openly, opposed the war party. But, however that may be, I assert that Mr. Gladstone neither has produced, nor can produce, a passage of my writing which affords the slightest foundation for this particular article of his indictment.

PROP. 5. *His examination of the text of Josephus is alike one-sided, inadequate, and erroneous.*

Easy to say, hard to prove. So long as the authorities whom I have cited are on my side, I do not know why this singularly temperate and convincing dictum should trouble me. I have yet to become acquainted with Mr. Gladstone's claims to speak with an authority equal to that of scholars of the rank of Schürer, whose obviously just and necessary emendations he so unceremoniously pooh-poohs.

PROP. 6. *Finally, he sets aside, on grounds not critical or historical, but partly subjective, the primary historical testimony on the subject, namely, that of the three Synoptic Evangelists, who write as contemporaries and deal directly with the subject, neither of which is done by any other authority.*

Really this is too much! The fact is, as anybody can see who will turn to my article of February 1889 [VII. *supra*], out of which all this discussion has arisen, that the arguments upon which I rest the strength of my case touching the swine-miracle, are exactly "historical" and "critical." Expressly, and in words that cannot be misunderstood, I refuse to rest on what Mr. Gladstone calls "subjective" evidence. I abstain from denying the possibility of the Gadarene occurrence, and I even go so far as to speak of some physical analogies to possession. In fact, my quondam opponent, Dr. Wace, shrewdly, but quite fairly, made the most of these admissions; and stated that I had removed the only "consideration which would have been a serious obstacle" in the way of his belief in the Gadarene story.[8]

So far from setting aside the authority of the synoptics on "subjective" grounds, I have taken a great deal of trouble to show that my non-belief in the story is based upon what appears to me to be evident; firstly, that the accounts of the three synoptic Gospels are not independent, but are founded upon a common source; secondly, that, even if the story of the common tradition proceeded from a contemporary, it would still be worthy of very little credit, seeing the manner in which the legends about mediæval miracles have been propounded by contemporaries. And in illustration of this position I wrote a special essay about the miracles reported by Eginhard.[9]

In truth, one need go no further than Mr. Gladstone's sixth proposition to be convinced that contemporary testimony, even of well-known and distinguished persons, may be but a very frail reed for the support of the historian, when theological prepossession blinds the witness.[10]

PROP. 7. *And he treats the entire question, in the narrowed form in which it arises upon secular testimony, as if it were capable of a solution so clear and summary as to warrant the use of the*

extremest weapons of controversy against those who presume to differ from him.

The six heretical propositions which have gone before are enunciated with sufficient clearness to enable me to prove, without any difficulty, that, whosesoever they are, they are not mine. But number seven, I confess, is too hard for me. I cannot undertake to contradict that which I do not understand.

What is the "entire question" which "arises" in a "narrowed form" upon "secular testimony"? After much guessing, I am fain to give up the conundrum. The "question" may be the ownership of the pigs; or the ethnological character of the Gadarenes; or the propriety of meddling with other people's property without legal warrant. And each of these questions might be so "narrowed" when it arose on "secular testimony" that I should not know where I was. So I am silent on this part of the proposition.

But I do dimly discern, in the latter moiety of this mysterious paragraph, a reproof of that use of "the extremest weapons of controversy" which is attributed to me. Upon which I have to observe that I guide myself, in such matters, very much by the maxim of a great statesman, "Do ut des." If Mr. Gladstone objects to the employment of such weapons in defence, he would do well to abstain from them in attack. He should not frame charges which he has, afterwards, to admit are erroneous, in language of carefully calculated offensiveness ("Impregnable Rock," pp. 269-70); he should not assume that persons with whom he disagrees are so recklessly unconscientious as to evade the trouble of inquiring what has been said or known about a grave question ("Impregnable Rock," p. 273); he should not qualify the results of careful thought as "hand-over-head reasoning" ("Impregnable Rock," p. 274); he should not, as in the extraordinary propositions which I have just analysed, make assertions respecting his opponent's position and arguments which are contradicted by the plainest facts.

Persons who, like myself, have spent their lives outside the political world, yet take a mild and philosophical concern in what goes on in it, often find it difficult to understand what our neighbours call the psychological moment of this or that party leader, and are, occasionally, loth to believe in the seeming conditions of certain kinds of success. And when some chieftain, famous in political warfare, adventures into the region of letters or of science, in full confidence that the methods which have brought fame and honour in his own province will answer there, he is apt to forget that he will be judged by these people, on whom rhetorical artifices have long ceased to take effect; and to whom mere dexterity in putting together cleverly ambiguous phrases, and even the great art of offensive misrepresentation, are unspeakably wearisome. And, if that weariness finds its expression in sarcasm, the offender really has no right to cry out. Assuredly, ridicule is no test of truth, but it is the righteous meed of some kinds of error. Nor ought the attempt to confound the expression of a revolted sense of fair dealing with arrogant impatience of contradiction, to restrain those to whom "the extreme weapons of controversy" come handy from using them. The function of police in the intellectual, if not in the civil, economy may sometimes be legitimately discharged by volunteers.

Some time ago, in one of the many criticisms with which I am favoured, I met with the remark that, at our time of life, Mr. Gladstone and I might be better occupied than in fighting over the Gadarene pigs. And, if these too famous swine were the only parties to the suit, I, for my part, should fully admit the

justice of the rebuke. But, under the beneficent rule of the Court of Chancery, in former times, it was not uncommon, that a quarrel about a few perches of worthless land, ended in the ruin of ancient families and the engulfing of great estates; and I think that our admonisher failed to observe the analogy–to note the momentous consequences of the judgment which may be awarded in the present apparently insignificant action *in re* the swineherds of Gadara.

The immediate effect of such judgment will be the decision of the question, whether the men of the nineteenth century are to adopt the demonology of the men of the first century, as divinely revealed truth, or to reject it, as degrading falsity. The reverend Principal of King's College has delivered his judgment in perfectly clear and candid terms. Two years since, Dr. Wace said that he believed the story as it stands; and consequently he holds, as a part of divine revelation, that the spiritual world comprises devils, who, under certain circumstances, may enter men and be transferred from them to four-footed beasts. For the distinguished Anglican Divine and Biblical scholar, that is part and parcel of the teachings respecting the spiritual world which we owe to the founder of Christianity. It is an inseparable part of that Christian orthodoxy which, if a man rejects, he is to be considered and called an "infidel." According to the ordinary rules of interpretation of language, Mr. Gladstone must hold the same view.

If antiquity and universality are valid tests of the truth of any belief, no doubt this is one of the beliefs so certified. There are no known savages, nor people sunk in the ignorance of partial civilisation, who do not hold them. The great majority of Christians have held them and still hold them. Moreover the oldest records we possess of the early conceptions of mankind in Egypt and in Mesopotamia prove that exactly such demonology, as is implied in the Gadarene story, formed the substratum, and, among the early Accadians, apparently the greater part, of their supposed knowledge of the spiritual world. M. Lenormant's profoundly interesting work on Babylonian magic and the magical texts given in the Appendix to Professor Sayce's "Hibbert Lectures" lease no doubt on this head. They prove that the doctrine of possession, and even the particular case of pig possession,[11] were firmly believed in by the Egyptians and the Mesopotamians before the tribes of Israel invaded Palestine. And it is evident that these beliefs, from some time after the exile and probably much earlier, completely interpenetrated the Jewish mind, and thus became inseparably interwoven with the fabric of the synoptic Gospels.

Therefore, behind the question of the acceptance of the doctrines of the oldest heathen demonology as part of the fundamental beliefs of Christianity, there lies the question of the credibility of the Gospels, and of their claim to act as our instructors, outside that ethical province in which they appeal to the consciousness of all thoughtful men. And still, behind this problem, there lies another–how far do these ancient records give a sure foundation to the prodigious fabric of Christian dogma, which has been built upon them by the continuous labours of speculative theologians, during eighteen centuries?

I submit that there are few questions before the men of the rising generation, on the answer to which the future hangs more fatally, than this. We are at the parting of the ways. Whether the twentieth century shall see a recrudescence of the superstitions of mediæval papistry, or whether it shall witness the severance of the living body of the ethical ideal of prophetic Israel from the carcase, foul with savage superstitions and cankered with false philosophy, to which the theologians have bound it, turns upon

their final judgment of the Gadarene tale.

The gravity of the problems ultimately involved in the discussion of the legend of Gadara will, I hope, excuse a persistence in returning to the subject, to which I should not have been moved by merely personal considerations.

With respect to the diluvial invective which overflowed thirty-three pages of the "Nineteenth Century" last January, I doubt not that it has a catastrophic importance in the estimation of its author. I, on the other hand, may be permitted to regard it as a mere spate; noisy and threatening while it lasted, but forgotten almost as soon as it was over. Without my help, it will be judged by every instructed and clear-headed reader; and that is fortunate, because, were aid necessary, I have cogent reasons for withholding it.

In an article characterised by the same qualities of thought and diction, entitled "**A Great Lesson**," which appeared in the "Nineteenth Century" for September 1887, the Duke of Argyll, firstly, charged the whole body of men of science, interested in the question, with having conspired to ignore certain criticisms of Mr. Darwin's theory of the origin of coral reefs; and, secondly, he asserted that some person unnamed had "actually induced" Mr. John Murray to delay the publication of his views on that subject "for two years."

It was easy for me and for others to prove that the first statement was not only, to use the Duke of Argyll's favourite expression, "contrary to fact," but that it was without any foundation whatever. The second statement rested on the Duke of Argyll's personal authority. All I could do was to demand the production of the evidence for it. Up to the present time, so far as I know, that evidence has not made its appearance; nor has there been any withdrawal of, or apology for, the erroneous charge.

Under these circumstances most people will understand why the Duke of Argyll may feel quite secure of having the battle all to himself, whenever it pleases him to attack me.

[See the note at the end of "Hasisadra's Adventure" (vol iv. p. 283). The discussion on coral reefs, at the meeting of the British Association this year, proves that Mr. Darwin's views are defended now, as strongly as in 1891, by highly competent authorities. October 25, 1893.]

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[1] *Nineteenth Century*, February 1891, pp. 339-40.

[2] Neither is it of any consequence whether the locality of the supposed miracle was Gadara, or Gerasa, or Gergesa. But I may say that I was well acquainted with Origen's opinion respecting Gergesa. It is fully discussed and rejected in Riehm's *Handwörterbuch.* In Kitto's *Biblical Cyclopædia* (ii. p. 51) Professor Porter remarks that Origen merely "*conjectures*" that Gergesa was indicated; and he adds, "Now, in a question of this kind conjectures cannot be admitted. We must implicitly follow the most ancient and creditable testimony, which

clearly pronounces in favour of [the Gadarenes]. This reading is adopted by Tischendorf, Alford, and Tregelles."

[3] I may call attention, in passing, to the fact that this authority, at any rate, has no sort of doubt of the fact that Jewish Law did not rule in Gadara (indeed, under the head of "Gadara," in the same work, it is expressly stated that the population of the place consisted "predominantly of heathens"), and that he scouts the notion that the Gadarene swineherds were Jews.

[4] The evidence adduced, so far as post-exile times are concerned, appears to me insufficient to prove this assertion.

[5] Even Leviticus xi. 26, cited without reference to the context, will not serve the purpose; because the swine *is* "cloven-footed" (Lev. xi 7).

[6] 1st Gospel: "And the devils *besought him,* saying, If Thou cast us out send us away *into* the herd of swine." 2d Gospel: "They *besought him,* saying, Send us *into* the swine." 3d Gospel 'They *intreated him* that he would give them leave to enter *into* them."

[7] See Marquardt, *Ramische Staatsverwaltung,* Bd. III, p. 408.

[8] *Nineteenth Century,* March 1889 (p. 362).

[9] "The Value of Witness to the Miraculous." *Nineteenth Century,* March 1889.

[10] I cannot ask the Editor of this Review to reprint pages of an old article,–but the following passages sufficiently illustrate the extent and the character of the discrepancy between the facts of the case and Mr. Gladstone's account of them:–

"Now, in the Gadarene affair, I do not think I am unreasonably sceptical if I say that the existence of demons who can be transferred from a man to a pig does thus contravene probability. Let me be perfectly candid. I admit I have no *a priori* objection to offer. . . . I declare, as plainly as I can, that I am unable to show cause why these transferable devils should not exist." . . . ("Agnosticism," *Nineteenth Century,* 1889, p. 177).

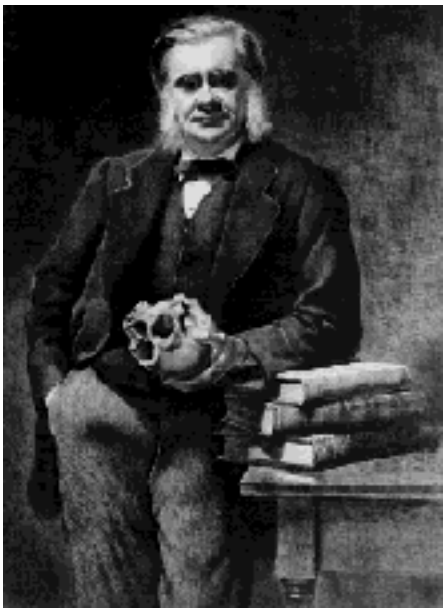
"What then do we know about the originator, or originators, of this groundwork–of that threefold tradition which all three witnesses (in Paley's phrase) agree upon–that we should allow their mere statements to outweigh the counter arguments of humanity, of common sense, or exact science, and to imperil the respect which all would be glad to be able to render to their Master?" (*ibid.*, p.175).

I then go on through a couple of pages to discuss the value of the evidence of the synoptics on critical and historical grounds. Mr. Gladstone cites the essay from which these passages are taken, whence I suppose he has read it; though it may be that he shares the impatience of Cardinal Manning where my writings are concerned. Such impatience will account for, though it will not excuse, his sixth proposition.

[11] The wicked, before being annihilated, returned to the world to disturb men; they entered into the body of

unclean animals, "often that of a pig, as on the Sarcophagus of Seti I. in the Soane Museum."–Lenormant, *Chaldean Magic*, p. 88, Editorial note.

THE HUXLEY FILE



Preface and Table of Contents to Volume V, *Science and Christian Tradition,* of Huxley's *Collected Essays.*

Previous article: The Keepers of the Herd of Swine [1890], pages 366-392.

Preface and Table of Contents to the next volume, Volume VI, *Hume,* of Huxley's *Collected Essays.*

C. Blinderman & D. Joyce
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Hume
With Helps to the Study of Berkeley

PART I.–HUME'S LIFE

Chapter I Early Life: Literary and Political Writings

[3] David Hume was born in Edinburgh on the 26th of April (O.S.), 1711. His parents were then residing in the parish of the Tron church, apparently on a visit to the Scottish capital, as the small estate which his father, Joseph Hume, or Home, inherited, lay in Berwickshire, on the banks of the Whitadder or Whitewater; a few miles from the border, and within sight of English ground. The paternal mansion was little more than a very modest farmhouse,[1] and the property derived its name of Ninewells from a considerable [4] spring, which breaks out on the slope in front of the house, and falls into the Whitadder.

Both mother and father came of good Scottish families–the paternal line running back to Lord Home of Douglas, who went over to France with the Douglas during the French wars of Henry V. and VI. and was killed at the battle of Verneuil. Joseph Hume died when David was an infant, leaving himself and two elder children, a brother and a sister, to the care of their mother, who is described by David Hume in "My Own Life" as "a woman of singular merit, who though young and handsome devoted herself entirely to the rearing and education of her children." Mr. Burton says: "Her portrait, which I have seen, represents a thin but pleasing countenance, expressive of great intellectual acuteness;" and as Hume told Dr. Black that she had "precisely the same constitution with himself" and died of the disorder which proved fatal to him, it is probable that the qualities inherited from his mother had much to do with the future philosopher's eminence. It is curious, however, that her estimate of her son in her only recorded, and perhaps slightly apocryphal utterance, is of a somewhat unexpected character. "Our Davie's a fine good-natured crater, but uncommon wake-minded." The first part of the judgment was indeed verified by "Davie's" whole life; but one might seek in vain for signs of what is commonly understood as [5] "weakness of mind" in a man who not only showed himself to be an intellectual athlete, but who had an eminent share of practical wisdom and tenacity of purpose. One would like to know, however, when it was that Mrs. Hume committed herself to this not too flattering judgment of her younger son. For as Hume reached the mature age of four and thirty, before he obtained any employment of sufficient importance to convert the meagre pittance of a middling laird's younger brother into a decent maintenance, it is not improbable that a shrewd Scots wife may have thought his devotion to philosophy and poverty to be due to mere infirmity of purpose. But she lived till 1749, long enough to see more than the dawn of her son's literary fame and official importance, and probably changed her mind about "Davie's" force of character.

David Hume appears to have owed little to schools or universities. There is some evidence that he entered the Greek class in the University of Edinburgh in 1723–when he was a boy of twelve years of age–but it is not known how long his studies were continued, and he did not graduate. In 1727, at any

rate, he was living at Ninewells, and already possessed by that love of learning and thirst for literary fame, which, as "My Own Life" tells us, was the ruling passion of his life and the chief source of his enjoyments. A letter of this date, addressed to his friend [6] Michael Ramsay, is certainly a most singular production for a boy of sixteen. After sundry quotations from Virgil the letter proceeds:–

"The perfectly wise man that outbraves fortune, is much greater than the husbandman who slips by her; and, indeed, this pastoral and saturnian happiness I have in a great measure come at just now. I live like a king, pretty much by myself, neither full of action nor perturbation–*molles somnos.* This state, however, I can foresee is not to be relied on. My peace of mind is not sufficiently confirmed by philosophy to withstand the blows of fortune. This greatness and elevation of soul is to be found only in study and contemplation. This alone can teach us to look down on human accident. You must allow [me] to talk thus like a philosopher: 'tis a subject I think much on; and could talk all day long of."

If David talked in this strain to his mother her tongue probably gave utterance to "Bless the bairn!" and, in her private soul, the epithet "wake-minded" may then have recorded itself. But, though few lonely, thoughtful, studious boys of sixteen give vent to their thoughts in such stately periods, it is probable that the brooding over an ideal is commoner at this age, than fathers and mothers, busy with the cares of practical life, are apt to imagine.

About a year later, Hume's family tried to launch him into the profession of the law; but, as he tells us, "while they fancied I was poring upon Voet and Vinnius, Cicero and Virgil were the authors which I was secretly devouring," and the attempt seems to have come to an abrupt termin[7] ation; Nevertheless, as a very competent authority[2] wisely remarks:–

"There appear to have been in Hume all the elements of which a good lawyer is made: clearness of judgment, power of rapidly acquiring knowledge, untiring industry, and dialectic skill: and if his mind had not been preoccupied, he might have fallen into the gulf in which many of the world's greatest geniuses lie buried–professional eminence; and might have left behind him a reputation limited to the traditional recollections of the Parliament house, or associated with important decisions. He was through life an able, clear-headed man of business, and I have seen several legal documents written in his own hand and evidently drawn by himself. They stand the test of general professional observation; and their writer, by preparing documents of facts of such a character on his own responsibility, showed that he had considerable confidence in his ability to adhere to the forms adequate for the occasion. He talked of it as 'an ancient prejudice industriously propagated by the dunces in all countries, that a *man of genius is unfit for business,*' and he showed, in his general conduct through life, that he did not choose to come voluntarily under this proscription."

Six years longer Hume remained at Ninewells before he made another attempt to embark in a practical career–this time commerce–and with a like result. For a few months' trial proved that kind of life, also, to be hopelessly against the grain.

It was while in London, on his way to Bristol, where he proposed to commence his mercantile [8] life, that Hume addressed to some eminent London physician (probably, as Mr. Burton suggests, Dr. George Cheyne) a remarkable letter. Whether it was ever sent seems doubtful; but it shows that philosophers as

well as poets have their Werterian crises, and it presents an interesting parallel to John Stuart Mill's record of the corresponding period of his youth. The letter is too long to be given in full, but a few quotations may suffice to indicate its importance to those who desire to comprehend the man.

"You must know then that from my earliest infancy I found always a strong inclination to books and letters. As our college education in Scotland, extending little further than the languages, ends commonly when we are about fourteen or fifteen years of age, I was after that left to my own choice in my reading, and found it incline me almost equally to books of reasoning and philosophy, and to poetry and the polite authors. Every one who is acquainted either with the philosophers or critics, knows that there is nothing yet established in either of these two sciences, and that they contain little more than endless disputes, even in the most fundamental articles. Upon examination of these, I found a certain boldness of temper growing on me, which was not inclined to submit to any authority in these subjects, but led me to seek out some new medium, by which truth might be established. After much study and reflection on this, at last, when I was about eighteen years of age, there seemed to be opened up to me a new scene of thought, which transported me beyond measure, and made me, with an ardour natural to young men, throw up every other pleasure or business to apply entirely to it. The law, which was the business I designed to follow, appeared nauseous to me, and I could think of no other way of pushing my fortune in the word, but that of a scholar and philosopher. [9] I was infinitely happy in this course of life for some months; till at last, about the beginning of September, 1729, all my ardour seemed in a moment to be extinguished, and I could no longer raise my mind to that pitch, which formerly gave me such excessive pleasure."

This "decline of soul" Hume attributes, in part, to his being smitten with the beautiful representation of virtue in the works of Cicero, Seneca, and Plutarch, and being thereby led to discipline his temper and his will along with his reason and understanding.

"I was continually fortifying myself with reflections against death, and poverty, and shame, and pain, and all the other calamities of life."

And he adds very characteristically:–

"These no doubt are exceeding useful when joined with an active life, because the occasion being presented along with the reflection, works it into the soul, and makes it take a deep impression: but, in solitude, they serve to little other purpose than to waste the spirits, the force of the mind meeting no resistance, but wasting itself in the air, like our arm when it misses its aim."

Along with all this mental perturbation, symptoms of scurvy, a disease now almost unknown among landsmen, but which, in the days of winter salt meat, before root crops flourished in the Lothians, greatly plagued our forefathers, made their appearance. And, indeed, it may be suspected that physical conditions were, at first, at the bottom of the whole business; for, in 1731, a ravenous appetite set in and, in six weeks from [10] being tall, lean, and raw-boned, Hume says he became sturdy and robust, with a ruddy complexion and a cheerful countenance–eating, sleeping, and feeling well, except that the capacity for intense mental application seemed to be gone. He, therefore, determined to seek out a more active life; and, though he could not and would not "quit his pretensions to learning, but with his last breath," he resolved "to lay them aside for some time, in order the more effectually to resume them."

The careers open to a poor Scottish gentleman in those days were very few; and, as Hume's option lay between a travelling tutorship and a stool in a merchant's office, he chose the latter.

"And having got recommendation to a considerable trader in Bristol, I am just now hastening thither, with a resolution to forget myself, and everything that is past, to engage myself, as far as is possible, in that course of life, and to toss about the world from one pole to the other, till I leave this distemper behind me."[3]

But it was all of no use–Nature would have her way–and in the middle of 1736, David Hume, aged twenty-three, without a profession or any assured means of earning a guinea; and having doubtless, by his apparent vacillation, but real tenacity of purpose, once more earned the [11] title of "wake-minded" at home; betook himself to a foreign country.

"I went over to France, with a view of prosecuting my studies in a country retreat: and there I laid that plan of life which I have steadily and successfully pursued. I resolved to make a very rigid frugality supply my deficiency of fortune, to maintain unimpaired my independency, and to regard every object as contemptible except the improvement of my talents in literature."[4]

Hume passed through Paris on his way to Rheims, where he resided for some time; though the greater part of his three years' stay was spent at La Flêche, in frequent intercourse with the Jesuits of the famous college in which Descartes was educated. Here he composed his first work, the "Treatise of Human Nature"; though it would appear from the following passage in the letter to Cheyne, that he had been accumulating materials to that end for some years before he left Scotland.

"I found that the moral philosophy transmitted to us by antiquity laboured under the same inconvenience that has been found in their natural philosophy, of being entirely hypothetical, and depending more upon invention than experience: every one consulted his fancy in erecting schemes of virtue and happiness, without regarding human nature, upon which every moral conclusion must depend."

This is the key-note of the "Treatise"; of which Hume himself says apologetically, in one of his letters, that it was planned before he was [12] twenty-one and composed before he had reached the age of twenty-five.[5]

Under these circumstances, it is probably the most remarkable philosophical work, both intrinsically and in its effects upon the course of thought, that has ever been written. Berkeley, indeed, published the "Essay Towards a New Theory of Vision," the "Treatise Concerning the Principles of Human Knowledge," and the "Three Dialogues," between the ages of twenty-four and twenty-eight; and thus comes very near to Hume, both in precocity and in influence; but his investigations are more limited in their scope than those of his Scottish contemporary,

The first and second volumes of the "Treatise," containing Book I., "Of the Understanding," and Book II.,"Of the Passions," were published in January, 1739. The publisher gave fifty pounds for the

copyright; which is probably more than an unknown writer of twenty-seven years of age would get for a similar work, at the present time. But, in other respects, its success fell far short of Hume's expectations. In a letter dated the 1st of June, 1739, he writes,–

"I am not much in the humour of such compositions at present, having received news from London of the success of [13] my 'Philosophy,' which is but indifferent, if I may judge by the sale of the book, and if I may believe my bookseller."

This, however, indicates a very different reception from that which Hume, looking through the inverted telescope of old age, ascribes to the "Treatise" in "My Own Life."

"Never literary attempt was more unfortunate than my 'Treatise of Human Nature.' It fell *deadborn from the press* without reaching such a distinction as even to excite a murmur among the zealots."

As a matter of fact, it was fully, and, on the whole, respectfully and appreciatively, reviewed in the "History of the Works of the Learned" for November, 1739.[6] Whoever the reviewer may have been, he was a man of discernment, for he says that the work bears "incontestable marks of a great capacity, of a soaring genius, but young, and not yet thoroughly practised;" and he adds, that we shall probably have reason to consider "this, compared with the later productions, in the same light as we view the juvenile works of a Milton, or the first manner of a Raphael or other celebrated painter." In a letter to Hutcheson, Hume merely speaks of this article as "somewhat abusive;" so that his vanity, being young and callow, seems to have been correspondingly wide-mouthed and hard to satiate.

[14] It must be confessed that, on this occasion, no less than on that of his other publications, Hume exhibits no small share of the craving after mere notoriety and vulgar success, as distinct from the pardonable, if not honourable, ambition for solid and enduring fame, which would have harmonised better with his philosophy. Indeed, it appears to be by no means improbable that this peculiarity of Hume's moral constitution was the cause of his gradually forsaking philosophical studies, after the publication of the third part ("On Morals") of the "Treatise," in 1740, and turning to those political and historical topics which were likely to yield, and did in fact yield, a much better return of that sort of success which his soul loved. The "Philosophical Essays Concerning the Human Understanding," which afterwards became the "Inquiry," is not much more than an abridgment and recast, for popular use, of parts of the "Treatise," with the addition of the essays on "Miracles" and on "Necessity." In style, it exhibits a great improvement on the "Treatise"; but the substance, if not deteriorated, is certainly not improved. Hume does not really bring his mature powers to bear upon his early speculations, in the later work. The crude fruits have not been ripened, but they have been ruthlessly pruned away, along with the branches which bore them. The result is a pretty shrub enough; but not the tree of knowledge, with its roots firmly [15] fixed in fact, its branches perennially budding forth into new truths, which Hume might have reared. Perhaps, after all, worthy Mrs. Hume was, in the highest sense, right. Davie was "wake-minded," not to see that the world of philosophy was his to overrun and subdue, if he would but persevere in the work he had begun. But no–he must needs turn aside for "success": and verily he had his reward; but not the crown he might have won.

In 1740, Hume seems to have made an acquaintance which rapidly ripened into a lifelong friendship. Adam Smith was, at that time, a boy student of seventeen at the University of Glasgow; and Hume sends a copy of the "Treatise" to "Mr. Smith," apparently on the recommendation of the well-known Hutcheson, Professor of Moral Philosophy in the university. It is a remarkable evidence of Adam Smith's early intellectual development, that a youth of his age should be thought worthy of such a present.

In 1741 Hume published anonymously, at Edinburgh, the first volume of "Essays Moral and Political," which was followed in 1742 by the second volume.

These pieces are written in an admirable style, and, though arranged without apparent method, a system of political philosophy may be gathered from their contents. Thus the third essay, "That Politics may be reduced to a Science," defends [16] that thesis, and dwells on the importance of forms of government.

"So great is the force of laws and of particular forms of government, and so little dependence have they on the humour and tempers of men, that consequences almost as general and certain may sometimes be deduced from them as any which the mathematical sciences afford us."–(III. 15.) (*See* p. 45.)

Hume proceeds to exemplify the evils which inevitably flow from universal suffrage, from aristocratic privilege, and from elective monarchy, by historical examples, and concludes:–

"That an hereditary prince, a nobility without vassals, and a people voting by their representatives, form the best monarchy, aristocracy, and democracy."–(III. 18.)

If we reflect that the following passage of the same essay was written nearly a century and a half ago, it would seem that whatever other changes may have taken place, political warfare remains *in statu quo:*–

"Those who either attack or defend a minister in such a government as our, where the utmost liberty is allowed, always carry matters to an extreme, and exaggerate his merit or demerit with regard to the public. His enemies are sure to charge him with the greatest enormities, both in domestic and foreign management; and there is no meanness or crime, of which, in their judgment, he is not capable. Unnecessary wars, scandalous treaties, profusion of public treasure, oppressive taxes, every kind of maladministration is ascribed to him. To aggravate the charge, his pernicious conduct, it is said, will extend its baneful influence even to posterity, by undermining [17] the best constitution in the world, and disordering that wise system of laws, institutions, and customs, by which our ancestors, during so many centuries, have been so happily governed. He is not only a wicked minister in himself, but has removed every security provided against wicked ministers for the future.

"On the other hand, the partisans of the minister make his panegyric rise as high as the accusation against him, and celebrate his wise, steady, and moderate conduct in every part of his administration. The honour and interest of the nation supported abroad, public credit maintained at home, persecution restrained, faction subdued: the merit of all these blessings is ascribed solely to the minister. At the same time, he crowns all his other merits by a religious care of the best government in the world, which he has preserved in all its parts, and has transmitted entire, to be the happiness and security of the latest posterity."–(III. 26.)

Hume sagely remarks that the panegyric and the accusation cannot both be true; and, that what truth there may be in either, rather tends to show that our much-vaunted constitution does not fulfil its chief object, which is to provide a remedy against maladministration. And if it does not–

"we are rather beholden to any minister who undermines it and affords us the opportunity of electing a better in its place."–(III. 28.)

The fifth Essay discusses the "Origin of Government":–

"Man, born in a family, is compelled to maintain society from necessity, from natural inclination, and from habit. The same creature, in his farther progress, is engaged to establish political society, in order to administer justice, without which there can be no peace among them, nor safety, nor mutual [18] intercourse. We are therefore to look upon all the vast apparatus of our government, as having ultimately no other object or purpose but the distribution of justice, or, in other words, the support of the twelve judges. Kings and parliaments, fleets and armies, officers of the court and revenue, ambassadors, ministers and privy councillors, are all subordinate in the end to this part of administration. Even the clergy, as their duty leads them to inculcate morality, may justly be thought, so far as regards this world, to have no other useful object of their institution."–(III. 37.)

The police theory of government has never been stated more tersely: and, if there were only one state in the world; and if we could be certain by intuition, or by the aid of revelation, that it is wrong for society, as a corporate body, to do anything for the improvement of its members and, thereby, indirectly support the twelve judges, no objection could be raised to it.

Unfortunately the existence of rival or inimical nations furnishes "kings and parliaments, fleets and armies," with a good deal of occupation beyond the support of the twelve judges; and, though the proposition that the State has no business to meddle with anything but the administration of justice, seems sometimes to be regarded as an axiom, it can hardly be said to be intuitively certain, inasmuch as a great many people absolutely repudiate it; while, as yet, the attempt to give it the authority of a revelation has not been made.

As Hume says with profound truth in the [19] fourth Essay, "On the First Principles of Government":

"As force is always on the side of the governed, the governors have nothing to support them but opinion. It is, therefore, on opinion only that government is founded; and this maxim extends to the most despotic and most military governments, as well as to the most free and the most popular."–(III. 31.)

But if the whole fabric of social organisation rests on opinion, it may surely be fairly argued that, in the interests of self-preservation, if for no better reason, society has a right to see that the means of forming just opinions are placed within the reach of every one of its members; and, therefore, that due provision for education, at any rate, is a right and, indeed, a duty, of the state.

The three opinions upon which all government, or the authority of the few over the many, is founded, says Hume, are public interest, right to power, and right to property. No government can permanently

exist, unless the majority of the citizens, who are the ultimate depositary of Force, are convinced that it serves the general interest, that it has lawful authority, and that it respects individual rights:–

"A government may endure for several ages, though the balance of power and the balance of property do not coincide.... But where the original constitution allows any share of power, though small, to an order of men who possess a large share of property, it is easy for them gradually to stretch their authority, and bring the balance of power to coincide with that of property. This has been the case with the House of Commons in England."–(III. 34.)

[20] Hume then points out that, in his time, the authority of the Commons was by no means equivalent to the property and power it represented, and proceeds:–

"Were the members obliged to receive instructions from their constituents, like the Dutch deputies, this would entirely alter the case; and if such immense power and riches as those of all the Commons of Great Britain, were brought into the scale, it is not easy to conceive that the crown could either influence that multitude of people, or withstand that balance of property. It is true, the crown has great influence over the collective body in the elections of members; but were this influence, which at present is only exerted once in seven years, to be employed in bringing over the people to every vote, it would soon be wasted, and no skill, popularity, or revenue could support it. I must, therefore, be of opinion that an alteration in this particular would introduce a total alteration in our government, would soon reduce it to a pure republic; and, perhaps, to a republic of no inconvenient form."–(III. 35.)

Viewed by the light of subsequent events, this is surely a very remarkable example of political sagacity. The members of the House of Commons are not yet delegates; but, with the widening of, the suffrage and the rapidly increasing tendency to drill and organise the electorate, and to exact definite pledges from candidates, they are rapidly becoming, if not delegates, at least attorneys for committees of electors. The same causes are constantly tending to exclude men, who combine a keen sense of self-respect with large intellectual capacity, from a position in which the one is as constantly offended, as the other is neutralised. [21] Notwithstanding the attempt of George the Third to resuscitate the royal authority, Hume's fore-sight has bean so completely justified that no one now dreams of the crown exerting the slightest influence upon elections.

In the seventh Essay, Hume raises a very interesting discussion as to the probable ultimate result of the forces which were at work in the British Constitution in the first part of the eighteenth century:–

"There has been a sudden and sensible change in the Opinions of men, within these last fifty years, by the progress of learning and of liberty. Most people in this island have divested themselves of all superstitious reverence to names and authority; the clergy have much lost their credit; their pretensions and doctrines have been much ridiculed; and even religion can scarcely support itself in the world. The mere name of *king* commands little respect; and to talk of a king as God's vicegerent on earth, or to give him any of those magnificent titles which formerly dazzled mankind, would but excite laughter in every one."–(III. 54.)

In fact, at the present day, the danger to monarchy in Britain would appear to lie, not in increasing love for equality, for which, except as regards the law, Englishmen have never cared, but rather entertain an

aversion; nor in any abstract democratic theories, upon which the mass of Englishmen pour the contempt with which they view theories in general; but in the constantly increasing tendency of monarchy to become slightly absurd, from the ever-widening [22] discrepancy between modern political ideas and the theory of kingship. As Hume observes, even in his time, people had left off making believe that a king was a different species of man from other men; and, since his day, more and more such make-believes have become impossible; until the maintenance of kingship in coming generations seems likely to depend, entirely, upon whether it is the general opinion, that a hereditary president of our virtual republic will serve the general interest better than an elective one or not. The tendency of public feeling in this direction is patent, but it does not follow that a republic is to be the final stage of our government. In fact, Hume thinks not:–

"It is well known, that every government must come to a period, and that death is unavoidable to the political, as well as to the animal body. But, as one kind of death may be preferable to another, it may be inquired, whether it be more desirable for the British constitution to terminate in a popular government, or in an absolute monarchy? Here, I would frankly declare, that though liberty be preferable to slavery, in almost every case; yet I should rather wish to see an absolute monarch than a republic in this island. For let us consider what kind of republic we have reason to expect. The question is not concerning any fine imaginary republic of which a man forms a plan in his closet. There is no doubt but a popular government may be imagined more perfect than an absolute monarchy, or even than our present constitution. But what reason have we to expect that any such government will ever be established in Great Britain, upon the dissolution of our monarchy? If any single person acquire power enough to take our constitution to pieces, and put it up anew, he is really [23] an absolute monarch; and we have already had an instance of this kind, sufficient to convince us, that such a person will never resign his power, or establish any free government. Matters, therefore, must be trusted to their natural progress and operation; and the House of Commons, according to its present constitution, must be the only legislature in such a popular government. The inconveniences attending such a situation of affairs present themselves by thousands. If the House of Commons, in such a case, ever dissolve itself, which is not to be expected, we may look for a civil war every election. If it continue itself, we shall suffer all the tyranny of a faction subdivided into new factions. And, as such a violent government cannot long subsist, we shall at last, after many convulsions and civil wars, find repose in absolute monarchy, which it would have been happier for us to have established peaceably from the beginning. Absolute monarchy, therefore, is the easiest death, the true *Euthanasia* of the British constitution.

"Thus if we have more reason to be jealous of monarchy, because the danger is more imminent from that quarter; we have also reason to be more jealous of popular government, because that danger is more terrible. This may teach us a lesson of moderation in all our political controversies."–(III. 66).

One may admire the sagacity of these speculations, and the force and clearness with which they are expressed, without altogether agreeing with them. That an analogy between the social and bodily organism exists, and is, in many respects, clear and full of instructive suggestion, is undeniable. Yet a state answers, not to an individual, but to a generic type; and there is no reason, in the nature of things, why any generic type should die out. The type of the pearly *Nautilus*, highly organised as it is, has persisted with but little [24] change from the Silurian epoch till now; and, so long as terrestrial conditions remain approximately similar to what they are at present, there is no more reason why it should cease to exist in the next, than in the past, hundred million years or so. The true ground for doubting the possibility of the establishment of absolute monarchy in Britain is, that opinion seems to

have passed through, and left far behind, the stage at which such a change would be possible; and the true reason for doubting the permanency of a republic if it is ever established, lies in the fact, that a republic requires for its maintenance a far higher standard of morality and of intelligence in the members of the state than any other form of government. Samuel gave the Israelites a king because they were not righteous enough to do without one, with a pretty plain warning of what they were to expect from the gift. And, up to this time, the progress of such republics as have been established in the world has not been such, as to lead to any confident expectation that their foundation is laid on a sufficiently secure subsoil of public spirit, morality, and intelligence. On the contrary, they exhibit examples of personal corruption and of political profligacy as fine as any hotbed of despotism has ever produced, while they fail in the primary duty of the administration of justice, as none but an effete despotism has ever failed.

[25] Hume has been accused of departing, in his old age, from the liberal principles of his youth; and, no doubt, he was careful, in the later editions of the "Essays," to expunge everything that savoured of democratic tendencies. But the passage just quoted shows that this was no recantation, but simply a confirmation, by his experience of one of the most debased periods of English history, of those evil tendencies attendant on popular government, of which, from the first, he was fully aware.

In the ninth essay, "On the Parties of Great Britain," there occurs a passage which, while it affords evidence of the marvellous change which has taken place in the social condition of Scotland since 1741, contains an assertion respecting the state of the Jacobite party at that time, which at first seems surprising:–

"As violent things have not commonly so long a duration as moderate, we actually find that the Jacobite party is almost entirely vanished from among us, and that the distinction of *court* and *Country*, which is but creeping in at London, is the only one that is ever mentioned in this kingdom. Beside the violence and openness of the Jacobite party, another reason has perhaps contributed to produce so sudden and so visible an alteration in this part of Britain. There are only two ranks of men among us; gentlemen who have some fortune and education, and the meanest slaving poor; without any considerable number of that middling rank of men, which abound more in England, both in cities and in the country, than in any other part of the world. The slaving poor are incapable of any principles; gentlemen may be converted to true principles, by time and experience. The middling rank of men have curiosity and knowledge enough to form principles, but not [26] enough to form true ones, or correct any prejudices that they may have imbibed. And it is among the middling rank of people that Tory principles do at present prevail most in England."–(III. 80, note.)

Considering that the Jacobite rebellion of 1745 broke out only four years after this essay was published, the assertion that the Jacobite party had "almost entirely vanished in 1741" sounds strange enough: and the passage which contains it is omitted in the third edition of the "Essays," published in 1748. Nevertheless, Hume was probably right, as the outbreak of '45 was little better than a Highland raid, and the Pretender obtained no important following in the Lowlands.

No less curious, in comparison with what would be said nowadays, is Hume's remark in the essay on the "Rise of the Arts and Sciences" that–

"The English are become sensible of the scandalous licentiousness of their stage from the example of the French decency and morals. "–(111. 135.)

And it is perhaps as surprising to be told, by a man of Hume's literary power, that the first polite prose in the English language was written by Swift. Locke and Temple (with whom Sprat is astoundingly conjoined) "knew too little of the rules of art to be esteemed elegant writers," and the prose of Bacon, Harrington, and Milton is "altogether stiff and pedantic." Hobbes, who whether he should be called a "polite" writer or [27] not, is a master of vigorous English; Clarendon, Addison, and Steele (the last two, surely, were "polite" writers in all conscience) are not mentioned.

On the subject of "National character," about which more nonsense, and often very mischievous nonsense, has been and is talked than upon any other topic, Hume's observations are full of sense and shrewdness. He distinguishes between the *moral* and the *physical* causes of national character, enumerating under the former–

"The nature of the government, the revolutions of public affairs, the plenty or penury in which people live, the situation of the nation with regard to its neighbours, and such like circumstances."–(111. 225.)

and under the latter:–

"Those qualities of the air and climate, which are supposed to work insensibly on the temper, by altering the tone and habit of the body, and giving a particular complexion, which, though reflexion and reason may sometimes overcome it, will yet prevail among the generality of mankind, and have an influence on their manners."–(III. 225.)

While admitting and exemplifying the great influence of moral causes, Hume remarks–

"As to physical causes, I am inclined to doubt altogether of their operation in this particular; nor do I think that men owe anything of their temper or genius to the air, food, or climate. "–(111. 227.)

Hume certainly would not have accepted the "rice theory" in explanation of the social state of [28] the Hindoos; and, it may be safely assumed, that he would not have had recourse to the circumambience of the "melancholy main" to account for the troublous history of Ireland. He supports his views by a variety of strong arguments, among which, at the present conjuncture, it is worth noting that the following occurs–

"Where any accident, as a difference in language or religion, keeps two nations, inhabiting the same country, from mixing with one another, they will preserve during several centuries a distinct and even opposite set of manners. The integrity, gravity, and bravery of the Turks, form an exact contrast to the deceit, levity, and cowardice of the modern Greeks."–(III. 238)

The question of the influence of race, which plays so great a part in modern political speculations, was hardly broached in Hume's time, but he had an inkling of its importance:–

"I am apt to suspect the Negroes to be naturally inferior to the Whites. There scarcely ever was a civilised nation of that complexion, nor even any individual, eminent either in action or speculation.... Such a uniform and constant difference [between the negroes and the whites] could not happen in so many countries and ages, if nature had not made an original distinction between these breeds of men.... In Jamaica, indeed, they talk of one Negro as a man of parts and learning; but it is likely he is admired for slender accomplishments, like a parrot who speaks a few words plainly."–(III. 236.)

The "Essays" met with the success they deserved. Hume wrote to Henry Home in June, 1742:–

[29]"The Essays are all sold in London, as I am informed by two letters from English gentlemen of my acquaintance. There is a demand for them; and, as one of them tells me, Innys, the great bookseller in Paul's Churchyard, wonders there is not a new edition, for he cannot find copies for his customers. I am also told that Dr. Butler has everywhere recommended them; so that I hope that they will have some success."

Hume had sent Butler a copy of the "Treatise" and had called upon him, in London, but he was out of town; and being shortly afterwards made Bishop of Bristol, Hume seems to have thought that further advances on his part might not be well received.

Greatly comforted by this measure of success, Hume remained at Ninewells, rubbing up his Greek, until 1745; when, at the mature age of thirty-four, he made his entry into practical life, by becoming bear-leader to the Marquis of Annandale, a young nobleman of feeble body and feebler mind. As might have been predicted, this venture was not more fortunate than his previous ones; and, after a year's endurance, diversified latterly with pecuniary squabbles, in which Hume's tenacity about a somewhat small claim is remarkable, the engagement came to an end.

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[1] A picture of the house, taken from Drummond's *History of Noble British Families*, is to be seen in Chambers's *Book of Days* (April 26th), and if, as Drummond says, "It is a favourable specimen of the best Scotch lairds' houses," all that can be said is that the worst Scotch lairds must have been poorly lodged indeed.

[2] Mr. John Hill Burton, in his valuable *Life of Hume,* on which, I need hardly say, I have drawn freely for the materials of the present biographical sketch.

[3] One cannot but be reminded of young Descartes' renunciation of study for soldiering.

[4] *My Own Life.*

[5] Letter to Gilbert Elliot of Minto, 1751. "So vast an undertaking, planned before I was one-and-twenty, and composed before twenty-five, must necessarily be very defective. I have repented my haste a hundred and a hundred times."

[6] Burton, *Life*, vol. i. p. 169.

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[30] Chapter II

Later Years: The History of England

In 1744, Hume's friends had endeavoured to procure his nomination to the Chair of "Ethics and pneumatic philosophy"[1] in the University of Edinburgh. About this matter he writes to his friend William Mure:–

"The accusation of heresy, deism, scepticism, atheism, &c., &c., &c., was started against me; but never took, being bore down by the contrary authority of all the good company in town."

If the "good company in town" bore down the first three of those charges, it is to be hoped, for the sake of their veracity, that they knew their candidate chiefly as the very good company that he always was; and had paid as little attention, as good company usually does, to so solid a work as the "Treatise." Hume expresses a naive [31] surprise, not unmixed with indignation, that Hutcheson and Leechman, both clergymen and sincere, though liberal, professors of orthodoxy, should have expressed doubts as to his fitness for becoming a professedly presbyterian teacher of presbyterian youth. The town council, however, would not have him, and filled up the place with a safe nobody.

In May, 1746, a new prospect opened. General St. Clair was appointed to the command of an expedition to Canada, and he invited Hume, at a week's notice, to be his secretary; to which office that of judge advocate was afterwards added.

Hume writes to a friend: "The office is very genteel, 10s. a day, perquisites, and no expenses;" and, to another, he speculates on the chance of procuring a company in an American regiment. "But this I build not on, nor indeed am I very fond of it," he adds; and this was fortunate, for the expedition, after dawdling away the summer in port, was suddenly diverted to an attack on L'Orient, where it achieved a huge failure and returned ignominiously to England.

A letter to Henry Home, written when this unlucky expedition was recalled, shows that Hume had already seriously turned his attention to history. Referring to an invitation to go over to Flanders with the General, he says:

"Had I any fortune which would give me a prospect of leisure and opportunity to prosecute *my historical projects*, [32] nothing could be more useful to me, and I should pick up more literary knowledge in one campaign by being in the General's family, and being introduced frequently to the Duke's, than most officers could do after many years' service. But to what can all this serve? I am a philosopher, and so I suppose must continue."

But this vaticination was shortly to prove erroneous. Hume seems to have made a very favourable impression on General St. Clair, as he did upon every one with whom he came into personal contact; for, being charged with a mission to the Court of Turin, in 1748, the General insisted upon the appointment of Hume as his secretary. He further made him one of his aides-de-camp; so that the philosopher was obliged to encase his more than portly, and by no means elegant, figure in a military uniform. Lord Charlemont, who met him at Turin, says he was "disguised in scarlet," and that he wore his uniform "like a grocer of the train-bands." Hume, always ready for a joke at his own expense, tells of the considerate kindness with which, at a reception at Vienna, the Empress-dowager released him and his friends from the necessity of walking backwards. "We esteemed ourselves very much obliged to her for this attention, especially my companions, who were desperately afraid of my falling on them and crushing them."

Notwithstanding the many attractions of this appointment, Hume writes that he leaves home [33] "with infinite regret, where I had treasured up stores of study and plans of thinking for many years;" and his only consolation is that the opportunity of becoming conversant with state affairs may be profitable:–

"I shall have an opportunity of seeing courts and camps; and if I can afterward be so happy as to attain leisure and other opportunities, this knowledge may even turn to account to me as a man of letters, which I confess has always been the sole object of my ambition. I have long had an intention, in my riper years, of composing some history; and I question not but some greater experience in the operations of the field and the intrigues of the cabinet will be requisite, in order to enable me to speak with judgment on these subjects."

Hume returned to London in 1749, and during his stay there, his mother died, to his heartfelt sorrow. A curious story in connection with this event is told by Dr. Carlyle, who knew Hume well, and whose authority is perfectly trustworthy.

"Mr. Boyle hearing of it, soon after went to his apartment, for they lodged in the same house, where he found him in the deepest affliction and in a flood of tears. After the usual topics and condolences Mr. Boyle said to him, 'My friend, you owe this uncommon grief to having thrown off the principles of religion: for if you had not, you would have been consoled with the firm belief that the good lady, who was not only the best of mothers, but the most pious of Christians, was completely happy in the realms of the just.' To which David replied, 'Though I throw out my speculations to entertain the learned and metaphysical world, yet in other things I do not think so differently from the rest of the world as you imagine.'"

[34] If Hume had told this story to Dr. Carlyle, the latter would have said so; it must therefore have come from Mr. Boyle; and one would like to have the opportunity of cross-examining that gentleman as to Hume's exact words and their context, before implicitly accepting his version of the conversation. Mr. Boyle's experience of mankind must have been small, if he had not seen the firmest of believers overwhelmed with grief by a like loss, and as completely inconsolable. Hume may have thrown off Mr. Boyle's "principles of religion," but he was none the less a very honest man, perfectly open and candid, and the last person to use ambiguous phraseology among his friends; unless, indeed, he saw no other way of putting a stop to the intrusion of unmannerly twaddle amongst the bitter-sweet memories stirred in his affectionate nature by so heavy a blow.

The "Philosophical Essays" or "Inquiry" was published in 1748, while Hume was away with General St. Clair, and, on his return to England, he had the mortification to find it overlooked in the hubbub caused by Middleton's "Free Inquiry," and its bold handling of the topic of the "Essay on Miracles," by which Hume doubtless expected the public to be startled.

Between 1749 and 1751, Hume resided at Ninewells, with his brother and sister, and busied himself with the composition of his most finished, if not his most important works, the "Dialogues on [35] Natural Religion," the "Inquiry Concerning the Principles of Morals," and the "Political Discourses."

"The Dialogues on Natural Religion" were touched and re-touched, at intervals, for a quarter of a century, and were not published till after Hume's death: but the "Inquiry Concerning the Principles of Morals" appeared in 1751, and the "Political Discourses" in 1752. Full reference will be made to the two former in the exposition of Hume's philosophical views. The last has been well said to be the "cradle of political economy: and much as that science has been investigated and expounded in later times, these earliest, shortest, and simplest developments of its principles are still read with delight even by those who are masters of all the literature of this great subject."[2]

The "Wealth of Nations," the masterpiece of Hume's close friend, Adam Smith, it must be remembered, did not appear before 1776, so that, in political economy, no less than in philosophy, Hume was an original, a daring, and a fertile innovator.

The "Political Essays" had a great and rapid success; translated into French in 1753, and again in 1754, they conferred a European reputation upon their author; and, what was more to [36] the purpose, influenced the later French school of economists of the eighteenth century.

By this time, Hume had not only attained a high reputation in the world of letters, but he considered himself a man of independent fortune. His frugal habits had enabled him to accumulate £1,000, and he tells Michael Ramsay in 1751:–

"While interest remains as at present, I have £50 a year, a hundred pounds worth of books, great store of linens and fine clothes, and near £100 in my pocket; along with order, frugality, a strong spirit of independency, good health, a contented humour, and an unabated love of study. In these circumstances I must esteem myself one of the happy and fortunate; and so far from being willing to draw my ticket over again in the lottery of life, there are very few prizes with which I would make an exchange. After some deliberation, I am resolved to settle in Edinburgh, and hope I shall be able with these revenues to say with Horace:–

'Est bona librorum et provisa frugis in annum Copia.'"

It would be difficult to find a better example of the honourable independence and cheerful self-reliance which should distinguish a man of letters, and which characterised Hume throughout his career. By honourable effort, the boy's noble ideal of life, became the man's reality; and, at forty, Hume had the happiness of finding that he had not wasted his youth in the pursuit of illusions, but that "the solid

certainty of waking bliss" lay before him in the free play of his powers in their appropriate sphere.

[37] In 1751, Hume removed to Edinburgh and took up his abode on a flat in one of those prodigious houses in the Lawnmarket, which still excite the admiration of tourists; afterwards moving to a house in the Canongate. His sister joined him, adding £30 a year to the common stock; and, in one of his charmingly playful letters to Dr. Clephane, he thus describes his establishment, in 1783.

"I shall exult and triumph to you a little that I have now at last–being turned of forty, to my own honour, to that of learning, and to that of the pleasant age–arrived at the dignity of being a householder.

"About seven months ago, I got a house of my own, and completed a regular family, consisting of a head, viz., myself, and two inferior members, a maid and a cat. My sister has since joined me, and keeps me company. With frugality, I can reach, I find, cleanliness, warmth, light, plenty, and contentment. What would you have more? Independence? I have it in a supreme degree. Honour? That is not altogether wanting. Grace? That will come in time. A wife? That is none of the indispensable requisites of life. Books? That is one of them; and I have more than I can use. In short, I cannot find any pleasure of consequence which I am not possessed of in a greater or less degree: and, without any great effort of philosophy, I may be easy and satisfied.

"As there is no happiness without occupation, I have begun a work which will occupy me several years, and which yields me much satisfaction. 'Tis a History of Britain from the Union of the Crowns to the present time. I have already finished the reign of King James. My friends flatter me (by this I mean that they don't flatter me) that I have succeeded."

In 1752, the Faculty of Advocates elected Hume their librarian, an office which, though it [38] yielded little emolument–the salary was only forty pounds a year–was valuable as it placed the resources of a large library at his disposal. The proposal to give Hume even this paltry place caused a great outcry, on the old score of infidelity. But as Hume writes, in a jubilant letter to Clephane (February 4, 1752):–

"I carried the election by a considerable majority . . . What is more extraordinary, the cry of religion could not hinder the ladies from being violently my partisans, and I owe my success in a great measure to their solicitations. One has broke off all commerce with her lover because he voted against me! And Mr. Lockhart, in a speech to the Faculty, said there was no walking the streets, nor even enjoying one's own fireside, on account of their importunate zeal. The town says that even his bed was not safe for him, though his wife was cousin-german to my antagonist.

"'Twas vulgarly given out that the contest was between Deists and Christians, and when the news of my success came to the playhouse, the whisper rose that the Christians were defeated. Are you not surprised that we could keep our popularity, notwithstanding this imputation, which my friends could not deny to be well founded?"

It would seem that the "good company" was less enterprising in its asseverations in this canvass than in the last.

The first volume of the "History of Great Britain, containing the reign of James I. and Charles I.," was published in 1754. At first, the sale was large, especially in Edinburgh, and if notoriety *per se* was

Hume's object, he attained it. [39] But he liked applause as well as fame, and, to his bitter disappointment, he says:–

"I was assailed by one cry of reproach, disapprobation, and even detestation: English, Scotch, and Irish, Whig and Tory, Churchman and Sectary, Freethinker and Religionist, Patriot and Courtier, united in their rage against the man who had presumed to shed a generous tear for the fate of Charles I. and the Earl of Strafford; and after the first ebullitions of their fury were over, what was still more mortifying, the book seemed to fall into oblivion. Mr. Millar told me that in a twelvemonth he sold only forty-five copies of it. I scarcely, indeed, heard of one man in the three kingdoms, considerable for rank or letters, that could endure the book. I must only except the primate of England, Dr. Herring, and the primate of Ireland, Dr. Stone, which seem two odd exceptions. These dignified prelates separately sent me messages not to he discouraged."

It certainly is odd to think of David Hume being comforted in his affliction by the independent and spontaneous sympathy of a pair of archbishops. But the instincts of the dignified prelates guided them rightly; for, as the great painter of English history in Whig pigments has been careful to point out,[3] Hume's historical picture, though a great work, drawn by a master hand, has all the lights Tory, and all the shades Whig.

Hume's ecclesiastical enemies seem to have thought that their opportunity had now arrived; and an attempt was made to get the General [40] Assembly of 1756 to appoint a committee to inquire into his writings. But, after a keen debate, the proposal was rejected by fifty votes to seventeen. Hume does not appear to have troubled himself about the matter, and does not even think it worth mention in "My Own Life,"

In 1756 he tells Clephane that he is worth £1,600 sterling, and consequently master of an income which must have been wealth to a man of his frugal habits. In the same year, he published the second volume of the "History," which met with a much better reception than the first; and, in 1757, one of his most remarkable works, the "Natural History of Religion," appeared. In the same year, he resigned his office of librarian to the Faculty of Advocates, and he projected removal to London, probably to superintend the publication of the additional volume of the "History."

"I shall certainly be in London next summer; and probably to remain there during life: at least, if I can settle myself to my mind, which I beg you to have an eye to. A room in a sober discreet family, who would not be averse to admit a sober, discreet, virtuous, regular, quiet, good-natured man of a bad character–such a room, I say, would suit me extremely." [4]

The promised visit took place in the latter part of the year 1758, and he remained in the [41] metropolis for the greater part of 1759. The two volumes of the "History of England under the House of Tudor" were published in London, shortly after Hume's return to Edinburgh; and, according to his own account, they raised almost as great a clamour as the first two had done.

Busily occupied with the continuation of his historical labours, Hume remained in Edinburgh until 1763; when, at the request of Lord Hertford, who was going as ambassador to France, he was appointed to the

embassy; with the promise of the secretaryship, and, in the meanwhile, performing the duties of that office. At first, Hume declined the offer; but, as it was particularly honourable to so well abused a man, on account of Lord Hertford's high reputation for virtue and piety,[5] and no less advantageous by reason of the increase of fortune which it secured to him, he eventually accepted it.

In France, Hume's reputation stood far higher than in Britain; several of his works had been translated; he had exchanged letters with Montesquieu and with Helvetius; Rousseau had appealed to him; and the charming Madame de Boufflers had drawn him into a correspondence, [42] marked by almost passionate enthusiasm on her part, and as fair an imitation of enthusiasm as Hume was capable of, on his. In the extraordinary mixture of learning, wit, humanity, frivolity, and profligacy which then characterised the highest French society, a new sensation was worth anything, and it mattered little whether the cause thereof was a philosopher or a poodle; so Hume had a great success in the Parisian world. Great nobles feted him, and great ladies were not content unless the "gros David" was to be seen at their receptions, and in their boxes at the theatre. "At the opera his broad unmeaning face was usually to be seen *entre deux jolis minoris*," says Lord Charlemont.[6] Hume's cool head was by no means turned; but he took the goods the gods provided with much satisfaction; and everywhere won golden opinions by his unaffected good sense and thorough kindness of heart.

Over all this part of Hume's career, as over the surprising episode of the quarrel with Rousseau, if that can be called quarrel which was lunatic [43] malignity on Rousseau's side and thorough generosity and patience on Hume's, I may pass lightly. The story is admirably told by Mr. Burton, to whose volumes I refer the reader. Nor need I dwell upon Hume's short tenure of office in London, as Under-Secretary of State, between 1767 and 1769. Success and wealth are rarely interesting, and Hume's case is no exception to the rule.

According to his own description the cares of official life were not overwhelming.

"My way of life here is very uniform and by no means disagreeable. I have all the forenoon in the Secretary's house, from ten till three, when there arrive from time to time messengers that bring me all the secrets of the kingdom, and, indeed, of Europe, Asia, Africa, and America. I am seldom hurried; but have leisure at intervals to take up a book, or write a private letter, or converse with a friend that may call for me; and from dinner to bed-time is all my own. If you add to this that the person with whom I have the chief, if not only, transactions, is the most reasonable, equal-tempered, and gentleman-like man imaginable, and Lady Aylesbury the same, you will certainly think I have no reason to complain; and I am far from complaining. I only shall not regret when my duty is over; because to me the situation can lead to nothing, at least in all probability; and reading, and sauntering, and lounging, and dozing, which I call thinking, is my supreme happiness–I mean my full contentment."

Hume's duty was soon over, and he returned to Edinburgh in 1769, "very opulent" in the possession of £1,000 a year, and determined to take what remained to him of life pleasantly [44] and easily. In October, 1769, he writes to Elliot:–

"I have been settled here two months, and am here body and soul, without casting the least thought of regret to

London, or even to Paris . . . I live still, and must for a twelvemonth, in my old house in James's Court, which is very cheerful and even elegant, but too small to display my great talent for cookery, the science to which I intend to addict the remaining years of my life. I have just now lying on the table before me a receipt for making *soupe à la reine,* copied with my own hand; for beef and cabbage (a charming dish) and old mutton and old claret nobody excels me. I make also sheep's-head broth in a manner that Mr. Keith speaks of for eight days after, and the Duc de Nivernois would bind himself apprentice to my lass to learn it. I have already sent a challenge to David Moncrieff: you will see that in a twelvemonth he will take to the writing of history, the field I have deserted; for as to the giving of dinners, he can now have no further pretensions. I should have made a very bad use of my abode in Paris if I could not get the better of a mere provincial like him. All my friends encourage me in this ambition; as thinking it will redound very much to my honour."

In 1770, Hume built himself a house in the new town of Edinburgh, which was then springing up. It was the first house in the street, and a frolicsome young lady chalked upon the wall "St. David's Street." Hume's servant complained to her master, who replied, "Never mind, lassie, many a better man has been made a saint of before," and the street retains its title to this day.

In the following six years, the house in St. David's Street was the Centre of the accomplished [45] and refined society which then distinguished Edinburgh. Adam Smith, Blair, and Ferguson were within easy reach; and what remains of Hume's correspondence with Sir Albert Elliot, Colonel Edmonstone, and Mrs. Cockburn gives pleasant glimpses of his social surroundings, and enables us to understand his contentment with his absence from the more perturbed, if more brilliant, worlds of Paris and London.

Towards London, Londoners, and indeed Englishmen in general, Hume entertained a dislike, mingled with contempt, which was as nearly rancorous as any emotion of his could be. During his residence in Paris, in 1764 and 1765, he writes to Blair:–

"The taste for literature is neither decayed nor depraved here, as with the barbarians who inhabit the banks of the Thames."

And he speaks of the "general regard paid to genius and learning" in France as one of the points in which it most differs from England. Ten years later, he cannot even thank Gibbon for his History without the lefthanded compliment, that he should never have expected such an excellent work from the pen of an Englishman. Early in 1765, Hume writes to Millar:–

"The rage and prejudice of parties frighten me, and above all, this rage against the Scots, which is so dishonourable, and indeed so infamous, to the English nation. We hear that it [46] increases every day without the least appearance of provocation on our part. It has frequently made me resolve never in my life to set foot on English ground. I dread, if I should undertake a more modern history, the impertinence and ill manners to which it would expose me; and I was willing to know from you whether former prejudices had so far subsided as to ensure me of a good reception."

His fears were kindly appeased by Millar's assurance that the English were not prejudiced against the Scots in general, but against the particular Scot, Lord Bute, who was supposed to be the guide, philosopher, and friend, of both the King and his mother.

To care nothing about literature, to dislike Scotchmen, and to be insensible to the merits of David Hume, was a combination of iniquities on the part of the English nation, which would have been amply sufficient to ruffle the temper of the philosophic historian, who, without being foolishly vain, had certainly no need of what has been said to be the one form of prayer in which his countrymen, torn as they are by theological differences, agree; "Lord! gie us a gude conceit o' oursels." But when, to all this, these same Southrons added a passionate admiration for Lord Chatham, who was in Hume's eyes a charlatan; and filled up the cup of their abominations by cheering for "Wilkes and Liberty," Hume's wrath knew no bounds, and, between 1768 and 1770, he pours a perfect Jeremiad into the bosom of his friend Sir Gilbert Elliot.

[47] "Oh! how I long to see America and the East Indies revolted, totally and finally–the revenue reduced to half–public credit fully discredited by bankruptcy–the third of London in ruins, and the rascally mob subdued! I think I am not too old to despair of being witness to all these blessings.

"I am delighted to see the daily and hourly progress of madness and folly and wickedness in England. The consummation of these qualities are the true ingredients for making a fine narrative in history, especially if followed by some signal and ruinous convulsion–as I hope will soon be the case with that pernicious people!"

Even from the secure haven of James's Court, the maledictions continue to pour forth:–

"Nothing but a rebellion and bloodshed will open the eyes of that deluded people; though were they alone concerned, I think it is no matter what becomes of them.... Our government has become a chimera, and is too perfect, in point of liberty, for so rude a beast as an Englishman; who is a man, a bad animal too, corrupted by above a century of licentiousness. The misfortune is that this liberty can scarcely be retrenched without danger of being entirely lost; at least the fatal effects of licentiousness must first be made palpable by some extreme mischief resulting from it. I may wish that the catastrophe should rather fall on our posterity, but it hastens on with such large strides as to leave little room for hope.

"I am running over again the last edition of my History, in order to correct it still further. I either soften or expunge many villainous seditious Whig strokes which had crept into it. I wish that my indignation at the present madness, encouraged by lies, calumnies, imposture, and every infamous act usual among popular leaders, may not throw me into the opposite extreme."

[48] A wise wish, indeed. Posterity respectfully concurs therein; and subjects Hume's estimate of England and things English to such modifications as it would probably have undergone had the wish been fulfilled.

In 1775, Hume's health began to fail; and in the spring of the following year, his disorder, which appears to have been hæmorrhage of the bowels, attained such a height that he knew it must be fatal. So he made his will, and wrote "My Own Life," the conclusion of which is one of the most cheerful, simple, and dignified leave-takings of life and all its concerns, extant.

"I now reckon upon a speedy dissolution. I have suffered very little pain from my disorder; and what is more strange, have, notwithstanding the great decline of my person, never suffered a moment's abatement of spirits; insomuch that were I to name the period of my life which I should most choose to pass over again, I might be tempted to point to this later period. I possess the same ardour as ever in study and the same gaiety in company; I consider, besides, that a man of sixty-five, by dying, cuts off only a few years of infirmities; and though I see many symptoms of my literary reputation's breaking out at last with additional lustre, I know that I could have but few years to enjoy it. It is difficult to be more detached from life than I am at present.

"To conclude historically with my own character, I am, or rather was (for that is the style I must now use in speaking of myself, which emboldens me the more to speak my sentiments); I was, I say, a man of mild dispositions, of command of temper, of an open, social, and cheerful humour, capable of attachment, but little susceptible of enmity, and of great moderation in all my passions. Even my love of literary [49] fame, my ruling passion, never soured my temper, notwithstanding my frequent disappointments. My company was not unacceptable to the young and careless, as well as to the studious and literary; and as I took a particular pleasure in the company of modest women, I had no reason to be displeased with the reception I met with from them. In a word, though most men any wise eminent, have found reason to complain of calumny, I never was touched or even attacked by her baleful tooth; and though I wantonly exposed myself to the rage of both civil and religious factions, they seemed to be disarmed in my behalf of their wonted fury. My friends never had occasion to vindicate any one circumstance of my character and conduct; not but that the zealots, we may well suppose, would have been glad to invent and propagate any story to my disadvantage but they could never find any which they thought would wear the face of probability. I cannot say there is no vanity in making this funeral oration of myself, but I hope it is not a misplaced one; and this is a matter of fact which is easily cleared and ascertained."

Hume died in Edinburgh on the 25th of August, 1776, and, a few days later, his body, attended by a great concourse of people, who seemed to have anticipated for it the fate appropriate to the remains of wizards and necromancers, was deposited in a spot selected by himself, in an old burial-ground on the eastern slope of the Calton Hill.

From the summit of this hill, there is a prospect unequalled by any to be seen from the midst of a great city. Westward lies the Forth, and beyond it, dimly blue, the far away Highland hills; eastward, rise the bold contours of Arthur's Seat and the rugged crags of the Castle rock, with the gray Old Town of Edinburgh; while, far below, from a [50] maze of crowded thoroughfares, the hoarse murmur of the toil of a polity of energetic men is borne upon the ear. At times a man may be as solitary here as in a veritable wilderness; and may meditate undisturbedly upon the epitome of nature and of man–the kingdoms of this world–spread out before him.

Surely, there is a fitness in the choice of this last resting-place by the philosopher and historian, who saw so clearly that these two kingdoms form but one realm, governed by uniform laws and alike based on impenetrable darkness and eternal silence; and faithful to the last to that profound veracity which was the secret of his philosophic greatness, he ordered that the simple Roman tomb which marks his grave should bear no inscription but

DAVID HUME

BORN 1711. DIED 1776.

Leaving it to posterity to add the rest.

It was by the desire and at the suggestion of my friend, the Editor of this Series,[7] that I undertook to attempt to help posterity in the difficult business of knowing what to add to Hume's epitaph; and I might, with justice, throw upon him the responsibility of my apparent presumption in occupying a place among the men of [51] letters, who are engaged with him, in their proper function of writing about English Men of Letters.

That to which succeeding generations have made, are making, and will make, continual additions, however, is Hume's fame as a philosopher; and, though I know that my plea will add to my offence in some quarters, I must plead, in extenuation of my audacity, that philosophy lies in the province of science, and not in that of letters.

In dealing with Hume's Life, I have endeavoured, as far as possible, to make him speak for himself. If the extracts from his letters and essays which I have given do not sufficiently show what manner of man he was, I am sure that nothing I could say would make the case plainer. In the exposition of Hume's philosophy which follows, I have pursued the same plan, and I have applied myself to the task of selecting and arranging in systematic order, the passages which appeared to me to contain the clearest statements of Hume's opinions.

I should have been glad to be able to confine myself to this duty, and to limit my own comments to so much as was absolutely necessary to connect my excerpts. Here and there, however, it must be confessed that more is seen of my thread than of Hume's beads. My excuse must be an ineradicable tendency to try to make things clear; while, I may further hope, that there is nothing in what I may have said, which is incon[52]sistent with the logical development of Hume's principles.

My authority for the facts of Hume's life is the admirable biography, published in 1846, by Mr. John Hill Burton. The edition of Hume's works from which all citations are made is that published by Black and Tait in Edinburgh, in 1826. In this edition, the Essays are reprinted from the edition of 1777, corrected by the author for the press a short time before his death. It is well printed in four handy volumes; and as my copy has long been in my possession, and bears marks of much reading, it would have been troublesome for me to refer to any other. But, for the convenience of those who possess some other edition, the following table of the contents of the edition of 1826; with the paging of the four volumes, is given:–

VOLUME I.
TREATISE OF HUMAN NATURE.
Book I. *Of the Understanding*, p. 5 to the end, p. 347.

VOLUME II.

As the volume and the page of the volume are given in my references, it will be easy, by the help of this table, to learn where to look for any passage cited, in differently arranged editions.

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[1] "Pneumatic philosophy" must not be confounded with the theory of elastic fluids; though, as Scottish chairs have, before now, combined natural with civil history, the mistake would be pardonable.

[2] Burton's *Life of David Hume*, i. p. 354.

[3] Lord Macaulay, Article on History, *Edinburgh Review* vol. lxvii.

[4] Letter to Clephane, 3rd September, 1757.

[5] "You must know that Lord Hertford has so high a character for piety, that his taking me by the hand is a kind of regeneration to me, and all past offences are now wiped off. But all these views are trifling to one of my age and temper."–*Hume to Edmonstone*, 9th January, 1764. Lord Hertford had procured him a pension of £200 a year for life from the King and the secretaryship was worth £1,000 a year.

[6] "Madame d'Epinay gives a ludicrous account of Hume's performance when pressed into a *tableau*, as a Sultan between two slaves, personated for the occasion by two of the prettiest women in Paris:–

"Il les regarde attentivement, il *se frappe le ventre* et les genoux à plusieurs reprises et ne trouve jamais autre chose à leur dire que. Eh bien! mes demoiselles.–*Eh bien! vous voilà donc ... Eh bien! vous voilà ... vous voilà ici?* Cette phrase dura un quart d'heure sans qu'il pût en sortir. Une d'elles se leva d'impatience: Ah, dit-elle, je m'en étois bien doutée, cet homme n'est bon qu'a manger du veau!"–Burton's *Life of Hume*, vol. ii. p. 224.

[7] *English Man of Letters.* Edited by John Morley.

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[57] PART II.–HUME'S PHILOSOPHY

Chapter I

The Object and Scope of Philosophy

Kant has said that the business of philosophy is to answer three questions: What can I know? What ought I to do? and For what may I hope? But it is pretty plain that these three resolve themselves, in the long run, into the first. For rational expectation and moral action are alike based upon beliefs; and a belief is void of justification, unless its subject-matter lies within the boundaries of possible knowledge, and unless its evidence satisfies the conditions which experience imposes as the guarantee of credibility.

Fundamentally, then, philosophy is the answer to the question, What can I know? and it is by applying itself to this problem, that philosophy is properly distinguished as a special department of scientific research. What is commonly called science, whether mathematical, physical, or biological, consists of the answers which mankind have been able to give to the inquiry, What [58] do I know? They furnish us with the results of the mental operations which constitute thinking; while philosophy, in the stricter sense of the term, inquires into the foundation of the first principles which those operations assume or imply.

But though, by reason of the special purpose of philosophy, its distinctness from other branches of scientific investigation may be properly vindicated, it is easy to see that, from the nature of its subject-matter, it is intimately and, indeed, inseparably connected with one branch of science. For it is obviously impossible to answer the question, What can we know? unless, in the first place, there is a clear understanding as to what is meant by knowledge; and, having settled this point, the next step is to inquire how we come by that which we allow to be knowledge; for, upon the reply, turns the answer to the further question, whether, from the nature of the case, there are limits to the knowable or not. While, finally, inasmuch as What can I know? not only refers to knowledge of the past or of the present, but to the confident expectation which we call knowledge of the future; it is necessary to ask, further, what justification can be alleged for trusting to the guidance of our expectations in practical conduct.

It surely needs no argumentation to show, that the first problem cannot be approached without the examination of the contents of the mind; and the determination of how much of these contents [59] may be called knowledge. Nor can the second problem be dealt with in any other fashion; for it is only by the observation of the growth of knowledge that we can rationally hope to discover how knowledge grows. But the solution of the third problem simply involves the discussion of the data obtained by the investigation of the foregoing two.

Thus, in order to answer three out of the four subordinate questions into which What can I know? breaks up, we must have recourse to that investigation of mental phenomena, the results of which are embodied in the science of psychology.

Psychology is a part of the science of life or biology, which differs from the other branches of that science, merely in so far as it deals with the psychical, instead of the physical, phenomena of life.

As there is an anatomy of the body, so there is an anatomy of the mind; the psychologist dissects mental phenomena into elementary states of consciousness, as the anatomist resolves limbs into tissues, and tissues into cells. The one traces the development of complex organs from simple rudiments; the other follows the building up of complex conceptions out of simpler constituents of thought. As the physiologist inquires into the way in which the so-called "functions" of the body are performed, so the psychologist studies the so-called "faculties" of the mind. Even a [60] cursory attention to the ways and works of the lower animals suggests a comparative anatomy and physiology of the mind; and the doctrine of evolution presses for application as much in the one field as in the other.

But there is more than a parallel, there is a close and intimate connection between psychology and physiology. No one doubts that, at any rate, some mental states are dependent for their existence on the performance of the functions of particular bodily organs. There is no seeing without eyes, and no hearing without ears. If the origin of the contents of the mind is truly a philosophical problem, then the philosopher who attempts to deal with that problem, without acquainting himself with the physiology of sensation, has no more intelligent conception of his business than the physiologist, who thinks he can discuss locomotion, without an acquaintance with the principles of mechanics; or respiration, without some tincture of chemistry.

On whatever ground we term physiology, science, psychology is entitled to the same appellation; and the method of investigation which elucidates the true relations of the one set of phenomena will discover those of the other. Hence, as philosophy is, in great measure, the exponent of the logical consequences of certain data established by psychology; and as psychology itself differs from physical science only in the nature of its subject-[61]matter, and not in its method of investigation, it would seem to be an obvious conclusion, that philosophers are likely to be successful in their inquiries, in proportion as they are familiar with the application of scientific method to less abstruse subjects; just as it seems to require no elaborate demonstration, that an astronomer, who wishes to comprehend the solar system, would do well to acquire a preliminary acquaintance with the elements of physics. And it is accordant with this presumption, that the men who have made the most important positive additions to philosophy, such as Descartes, Spinoza, and Rant, not to mention more recent examples, have been deeply imbued with the spirit of physical science; and, in some cases, such as those of Descartes and Kant, have been largely acquainted with its details. On the other hand, the founder of Positivism no less admirably illustrates the connection of scientific incapacity with philosophical incompetence. In truth, the laboratory is the fore-court of the temple of philosophy; and whoso has not offered sacrifices and undergone purification there, has little chance of admission into the sanctuary.

Obvious as these considerations may appear to be, it would be wrong to ignore the fact that their force is by no means universally admitted. On the contrary, the necessity for a proper psychological and physiological training to the student [62] of philosophy is denied, on the one hand, by the "pure metaphysicians," who attempt to base the theory of knowing upon supposed necessary and universal truths, and assert that scientific observation is impossible unless such truths are already known or implied: which, to those who are not "pure metaphysicians," seems very much as if one should say that the fall of a stone cannot be observed, unless the law of gravitation is already in the mind of the observer.

On the other hand, the Positivists, so far as they accept the teachings of their master, roundly assert, at any rate in words, that observation of the mind is a thing inherently impossible in itself, and that psychology is a chimera–a phantasm generated by the fermentation of the dregs of theology. Nevertheless, if M. Comte had been asked what he meant by "physiologie cerebrale," except that which other people call "psychology"; and how he knew anything about the functions of the brain, except by that very "observation interieure," which he declares to be an absurdity–it seems probable that he would have found it hard to escape the admission, that, in vilipending psychology, he had been propounding solemn nonsense.

It is assuredly one of Hume's greatest merits that he clearly recognised the fact that philosophy is based upon psychology; and that the inquiry into the contents and the operations of the mind must [63] be conducted upon the same principles as a physical investigation, if what he calls the "moral philosopher" would attain results of as firm and definite a character as those which reward the "natural philosopher."[1] The title of his first work, a "Treatise of Human Nature, being an Attempt to introduce the Experimental method of Reasoning into Moral Subjects," sufficiently indicates the point of view from which Hume regarded philosophical problems; and he tells us in the preface, that his object has been to promote the construction of a "science of man."

"'Tis evident that all the sciences have a relation, greater or less, to human nature; and that, however wide any of them may seem to run from it, they still return back by one passage or another. Even *Mathematics, Natural Philosophy,* and *Natural Religion* are in some measure dependent on the science of Man; since they lie under the cognizance of men, and are judged of by their powers and qualities. 'Tis impossible to tell what changes and improvements we might make in these sciences were we thoroughly acquainted with the extent and force of human understanding, and could explain the nature of the ideas we employ and of the operations we perform in our reasonings . . . . To me it seems evident that the essence of mind being equally unknown to us with that of external bodies, it must be equally impossible to form any notion of its [64] powers and qualities otherwise than from careful and exact experiments, and the observation of those particular effects which result from its different circumstances and situations. And though we must endeavour to render all our principles as universal as possible, by tracing up our experiments to the utmost, and explaining all effects from the simplest and fewest causes, 'tis still certain we cannot go beyond experience: and any hypothesis that pretends to discover the ultimate original qualities of human nature, ought at first to be rejected as presumptuous and chimerical.....

"But if this impossibility of explaining ultimate principles should be esteemed a defect in the science of man, I will venture to affirm, that it is a defect common to it with all the sciences, and all the arts, in which we can employ ourselves, whether they be such as are cultivated in the schools of the philosophers, or practised in the shops of the meanest artizans. None of them can go beyond experience, or establish any principles which are not

founded on that authority. Moral philosophy has, indeed, this peculiar disadvantage, which is not found in natural, that in collecting its experiments, it cannot make them purposely, with premeditation, and after such a manner as to satisfy itself concerning every particular difficulty which may arise. When I am at a loss to know the effects of one body upon another in any situation I need only put them in that situation, and observe what results from it. But should I endeavour to clear up in the same manner any [2] doubt in moral philosophy, by placing myself in the same case with that which I consider, 'tis evident this reflection and premeditation would so disturb the operation of my natural principles, as must render it impossible to form any just conclusion from the phenomenon. We must, therefore, glean up our experiments in this science from a cautious observation of human life, and take them as they appear in the common course of the [65] world, by men's behaviour in company, in affairs, and in their pleasures. Where experiments of this kind are judiciously collected and compared, we may hope to establish on them a science which will not be inferior in certainty, and will be much superior in utility, to any other of human comprehension."–(I. pp 7–11.)

All science starts with hypotheses–in other words, with assumptions that are unproved, while they may be, and often are, erroneous; but which are better than nothing to the seeker after order in the maze of phenomena. And the historical progress of every science depends on the criticism of hypotheses–on the gradual stripping off, that is, of their untrue or superfluous parts–until there remains only that exact verbal expression of as much as we know of the fact, and no more, which constitutes a perfect scientific theory,

Philosophy has followed the same course as other branches of scientific investigation. The memorable service rendered to the cause of sound thinking by Descartes consisted in this: that he laid the foundation of modern philosophical criticism by his inquiry into the nature of certainty. It is a clear result of the investigation started by Descartes, that there is one thing of which no doubt can be entertained, for he who should pretend to doubt it would thereby prove its existence; and that is the momentary consciousness we call a present thought or feeling; that is safe, even if all other kinds of [66] certainty are merely more or less probable inferences. Berkeley and Locke, each in his way, applied philosophical criticism in other directions; but they always, at any rate professedly, followed the Cartesian maxim of admitting no propositions to be true but such as are clear, distinct, and evident, even while their arguments stripped off many a layer of hypothetical assumption which their great predecessor had left untouched. No one has more clearly stated the aims of the critical philosopher than Locke, in a passage of the famous "Essay concerning Human Understanding," which, perhaps, I ought to assume to be well known to all English readers, but which so probably is unknown to this full-crammed and much-examined generation that I venture to cite it:

"If by this inquiry into the nature of the understanding I can discover the powers thereof, how far they reach, to what things they are in any degree proportionate, and where they fail us, I suppose it may be of use to prevail with the busy mind of man to be more cautious in meddling with things exceeding his comprehension: to stop when it is at the utmost extent of its tether; and to sit down in quiet ignorance of those things which, upon examination, are proved to be beyond the reach of our capacities. We should not then, perhaps, be so forward, out of an affectation of universal knowledge, to raise questions and perplex ourselves and others with disputes about things to which our understandings are not suited, and of which we cannot frame in our minds any clear and distinct perception, or whereof (as it has, perhaps, too often happened) we have not any notion at all. ... Men may find matter sufficient to busy their heads and [67] employ their hands with variety, delight, and satisfaction, if

they will not boldly quarrel with their own constitution and throw away the blessings their hands are filled with because they are not big enough to grasp everything. We shall not have much reason to complain of the narrowness of our minds, if we will but employ them about what may be of use to us: for of that they are very capable: and it will be an unpardonable as well as a childish peevishness, if we undervalue the advantages of our knowledge, and neglect to improve it to the ends for which it was given us, because there are some things that are set out of reach of it. It will be no excuse to an idle and untoward servant who would not attend to his business by candlelight, to plead that he had not broad sunshine. The candle that is set up in us shines bright enough for all our purposes .... Our business here is not to know all things, but those which concern our conduct."[3]

Hume develops the same fundamental conception in a somewhat different way, and with a more definite indication of the practical benefits which may be expected from a critical philosophy. The first and second parts of the twelfth section of the "Inquiry" are devoted to a condemnation of excessive scepticism, or Pyrrhonism, with which Hume couples a caricature of the Cartesian doubt; but, in the third part, a certain "mitigated scepticism" is recommended and adopted, under the title of "academical philosophy." After pointing out that a knowledge of the infirmities of the human understanding, even in its most perfect state, and when most accurate and cautious [68] in its determinations, is the best check upon the tendency to dogmatism, Hume continues:–

"Another species of *mitigated* scepticism, which may be of advantage to mankind, and which may be the natural result of the Pyrrhonian doubts and scruples, is the limitation of our inquiries to such subjects as are best adapted to the narrow capacity of human understanding. The *imagination* of man is naturally sublime, delighted with whatever is remote and extraordinary, and running, without control, into the most distant parts of space and time in order to avoid the objects which custom has rendered too familiar to it. A correct *judgment* observes a contrary method, and, avoiding all distant and high inquiries, confines itself to common life, and to such subjects as fall under daily practice and experience; leaving the more sublime topics to the embellishment of poets and orators, or to the arts of priests and politicians. To bring us to so salutary a determination, nothing can be more serviceable than to be once thoroughly convinced of the force of the Pyrrhonian doubt, and of the impossibility that anything but the strong power of natural instinct could free us from it. Those who have a propensity to philosophy will still continue their researches; because they reflect, that, besides the immediate pleasure attending such an occupation, philosophical decisions are nothing but the reflections of common life, methodised and corrected. But they will never be tempted to go beyond common life, so long as they consider the imperfection of those faculties which they employ, their narrow reach and their inaccurate operations. While we cannot give a satisfactory reason why we believe, after a thousand experiments, that a stone will fall or fire burn; can we ever satisfy ourselves concerning any determination which we may form with regard to the origin of worlds and the situation of nature from and to eternity?" (IV. pp. 189–90.)

But further, it is the business of criticism not only to keep watch over the vagaries of phil[69] osophy, but to do the duty of police in the whole world of thought. Wherever it espies sophistry or superstition they are to be bidden to stand; nay, they are to be followed to their very dens and there apprehended and exterminated, as Othello smothered Desdemona, "else she'll betray more men."

Hume warms into eloquence as he sets forth the labours meet for the strength and the courage of the Hercules of "mitigated scepticism."

"Here, indeed, lies the justest and most plausible objection against a considerable part of metaphysics, that they are not properly a science, but arise either from the fruitless efforts of human vanity, which would penetrate into subjects utterly inaccessible to the understanding, or from the craft of popular superstitions, which, being unable to defend themselves on fair ground, raise these entangling brambles to cover and protect their weakness. Chased from the open country, these robbers fly into the forest, and lie in wait to break in upon every unguarded avenue of the mind and overwhelm it with religious fears and prejudices. The stoutest antagonist, if he remits his watch a moment, is oppressed; and many, through cowardice and folly, open the gates to the enemies, and willingly receive them with reverence and submission as their legal sovereigns.

"But is this a sufficient reason why philosophers should desist from such researches and leave superstition still in possession of her retreat? Is it not proper to draw an opposite conclusion, and perceive the necessity of carrying the war into the most secret recesses of the enemy? . . . . . The only method of freeing learning at once from these abstruse questions is to inquire seriously into the nature of human understanding and show, from an exact analysis of its powers and capacity that it is by no means fitted for such remote and abstruse [70] subjects. We must submit to this fatigue, in order to live at ease ever after; and must cultivate true metaphysics with some care, in order to destroy the false and adulterated."–(IV. pp. 10, 11.)

Near a century and a half has elapsed since these brave words were shaped by David Hume's pen; and the business of carrying the war into the enemy's camp has gone on but slowly. Like other campaigns, it long languished for want of a good base of operations. But since physical science, in the course of the last fifty years, has brought to the front an inexhaustible supply of heavy artillery of a new pattern, warranted to drive solid bolts of fact through the thickest skulls, things are looking better; though hardly more than the first faint flutterings of the dawn of the happy day, when superstition and false metaphysics shall be no more and reasonable folks may "live at ease," are as yet discernible by the *enfants perdus* of the outposts.

If, in thus conceiving the object and the limitations of philosophy, Hume shows himself the spiritual child and continuator of the work of Locke, he appears no less plainly as the parent of Kant and as the protagonist of that more modern way of thinking, which has been called "agnosticism," from its profession of an incapacity to discover the indispensable conditions of either positive or negative knowledge, in many propositions, respecting which, not only the vulgar, [71] but philosophers of the more sanguine sort, revel in the luxury of unqualified assurance.

The aim of the "Kritik der reinen Vernunft" is essentially the same as that of the "Treatise of Human Nature," by which indeed Kant was led to develop that "critical philosophy" with which his name and fame are indissolubly bound up: and, if the details of Kant's criticism differ from those of Hume, they coincide with them in their main result, which is the limitation of all knowledge of reality to the world of phenomena revealed to us by experience.

The philosopher of Konigsberg epitomises the philosopher of Ninewells when he thus sums up the uses of philosophy–

"The greatest and perhaps the sole use of all philosophy of pure reason is, after all, merely negative, since it serves, not as an organon for the enlargement [of knowledge], but as a discipline for its delimitation: and instead

of discovering truth, has only the modest merit of preventing error."[4]

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[1] In a letter to Hutcheson (September 17th, 1739) Hume remarks .–"There are different ways of examining the mind as well as the body. One may consider it either as an anatomist or as a painter: either to discover its most secret springs and principles, or to describe the grace and beauty of its actions;" and he proceeds to justify his own mode of looking at the moral sentiments from the anatomist's point of view.

[2] The manner in which Hume constantly refers to the results of the observation of the contents and the processes of his own mind clearly shows that he has here inadvertently overstated the case.

[3] Locke, *An Essay concerning Human Understanding* . Book I. chap i. §§ 4, 5, 6.

[4] *Kritik der reinen Vernunft.* Ed. Hartenstein, p. 256.

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[72] Chapter II

The Contents of the Mind

In the language of common life, the "mind" is spoken of as an entity, independent of the body, though resident in and closely connected with it, and endowed with numerous "faculties," such as sensibility, understanding, memory, volition, which stand in the same relation to the mind as the organs do to the body, and perform the functions of feeling, reasoning, remembering, and willing. Of these functions, some, such as sensation, are supposed to be merely passive–that is, they are called into existence by impressions, made upon the sensitive faculty by a material world of real objects, of which our sensations are supposed to give us pictures; others, such as the memory and the reasoning faculty, are considered to be partly passive and partly active; while volition is held to be potentially, if not always actually, a spontaneous activity.

[73] The popular classification and terminology of the phenomena of consciousness, however, are by no means the first crude conceptions suggested by common sense, but rather a legacy, and, in many respects, a sufficiently *damnosa hæreditas,* of ancient philosophy, more or less leavened by theology; which has incorporated itself with the common thought of later times, as the vices of the aristocracy of one age become those of the mob in the next. Very little attention to what passes in the mind is sufficient to show, that these conceptions involve assumptions of an extremely hypothetical character. And the first business of the student of psychology is to get rid of such prepossessions; to form conceptions of mental phenomena as they are given us by observation, without any hypothetical admixture, or with only so much as is definitely recognised and held subject to confirmation or otherwise; to classify these phenomena according to their clearly recognisable characters; and to adopt a nomenclature which suggests nothing beyond the results of observation. Thus chastened, observation of the mind makes us

acquainted with nothing but certain events, facts, or phenomena (whichever name be preferred) which pass over the inward field of view in rapid and, as it may appear on careless inspection, in disorderly succession, like the shifting patterns of a kaleidoscope. To all these mental phenomena, or states of our [74] consciousness,[1] Descartes gave the name of "thoughts,"[2] while Locke and Berkeley termed them "ideas." Hume, regarding this as an improper use of the word "idea," for which he proposes another employment, gives the general name of "perceptions" to all states of consciousness. Thus, whatever other signification we may see reason to attach to the word "mind," it is certain that it is a name which is employed to denote a series of perceptions; just as the word "tune," whatever else it may mean, denotes, in the first place, a succession of musical notes. Hume, indeed, goes further than others when he says that–

"What we call a mind is nothing but a heap or collection of different perceptions, united together by certain relations, and supposed, though falsely, to be endowed with a perfect simplicity and identity. "–(I. p. 268.)

With this "nothing but," however, he obviously falls into the primal and perennial error of philosophical speculators–dogmatising from negative arguments. He may be right or wrong; but [75] the most he, or anybody else, can prove in favour of his conclusion is, that we know nothing more of the mind than that it is a series of perceptions. Whether there is something in the mind that lies beyond the reach of observation; or whether perceptions themselves are the products of something which can be observed and which is not mind; are questions which can in nowise be settled by direct observation. Elsewhere, the objectionable hypothetical element of the definition of mind is less prominent–

"The true idea of the human mind is to consider it as a system of different perceptions, or different existences, which are linked together by the relation of cause and effect, and mutually produce, destroy, influence and modify each other . . . In this respect I cannot compare the soul more properly to anything than a republic or commonwealth, in which the several members are united by the reciprocal ties of government and surbordination, and give rise to other persons who propagate the same republic in the incessant changes of its parts."–(I. p. 331).

But, leaving the question of the proper definition of mind open for the present, it is further a matter of direct observation, that, when we take a general survey of all our perceptions or states of consciousness, they naturally fall into sundry groups or classes. Of these classes, two are distinguished by Hume as of primary importance. All "perceptions," he says, are either "*Impressions*" or "*Ideas.*"

Under "impressions" he includes "all our more [76] lively perceptions, when we hear, see, feel, love, or will;" in other words, "all our sensations, passions, and emotions, as they make their first appearance in the soul" (I. p. 15).

"Ideas," on the other hand, are the faint images of impressions in thinking and reasoning, or of antecedent ideas.

Both impressions and ideas may be either *simple*, when they are incapable of further analysis, or *complex*, when they may be resolved into simpler constituents. All simple ideas are exact copies of

impressions; but, in complex ideas, the arrangement of simple constituents may be different from that of the impressions of which those simple ideas are copies.

Thus the colours red and blue and the odour of a rose, are simple impressions; while the ideas of blue, of red, and of rose-odour are simple copies of these impressions. But a red rose gives us a complex impression, capable of resolution into the simple impressions of red colour, rose-scent, and numerous others; and we may have a complex idea, which is an accurate, though faint, copy of this complex impression. Once in possession of the ideas of a red rose and of the colour blue, we may, in imagination, substitute blue for red; and thus obtain a complex idea of a blue rose, which is not an actual copy of any complex impression though all its elements are such copies.

Hume has been criticised for making the [77] distinction of impressions and ideas to depend upon their relative strength or vivacity. Yet it would be hard to point out any other character by which the things signified can be distinguished. Any one who has paid attention to the curious subject of what are called "subjective sensations" will be familiar with examples of the extreme difficulty which sometimes attends the discrimination of ideas of sensation from impressions of sensation, when the ideas are very vivid, or the impressions are faint. Who has not "fancied" he heard a noise; or has not explained inattention to a real sound by saying, "I thought it was nothing but my fancy"? Even healthy persons are much more liable to both visual and auditory spectra–that is, ideas of vision and sound so vivid that they are taken for new impressions–than is commonly supposed; and, in some diseased states, ideas of sensible objects may assume all the vividness of reality.

If ideas are nothing but copies of impressions, arranged, either in the same order as that of the impressions from which they are derived, or in a different order, it follows that the ultimate analysis of the contents of the mind turns upon that of the impressions. According to Hume, these are of two kinds: either they are impressions of sensation, or they are impressions of reflection. The former are those afforded by the five senses, together with pleasure and pain. The [78] latter are the passions or the emotions (which Hume employs as equivalent terms). Thus the elementary states of consciousness, the raw materials of knowledge, so to speak, are either sensations or emotions; and whatever we discover in the mind, beyond these elementary states of consciousness, results from the combinations and the metamorphoses which they undergo.

It is not a little strange that a thinker of Hume's capacity should have been satisfied with the results of a psychological analysis which regards some obvious compounds as elements, while it omits altogether a most important class of elementary states.

With respect to the former point, Spinoza's masterly examination of the Passions in the third part of the "Ethics" should have been known to Hume.[3] But, if he had been acquainted with that wonderful piece of psychological anatomy, he would have learned that the emotions and passions are all complex states, arising from the close association of ideas of pleasure or pain with other ideas; and, indeed, without going to Spinoza, his own acute discussion of the passions leads to the same result,[4] and is wholly inconsistent [79] with his classification of those mental states among the primary uncompounded

materials of consciousness.

If Hume's "impressions of reflection" are excluded from among the primary elements of consciousness, nothing is left but the impressions afforded by the five senses, with pleasure and pain. Putting aside the muscular sense, which had not come into view in Hume's time, the questions arise whether these are all the simple undecomposable materials of thought? or whether others exist of which Hume takes no cognizance?

Kant answered the latter question in the affirmative, in the "Kritik der reinen Vernunft," and thereby made one of the greatest advances ever effected in philosophy; though it must be confessed that the German philosopher's exposition of his views is so perplexed in style, so burdened with the weight of a cumbrous and uncouth scholasticism, that it is easy to confound the unessential parts of his system with those [80] which are of profound importance. His baggage train is bigger than his army, and the student who attacks him is too often led to suspect he has won a position when he has only captured a mob of useless camp-followers.

In his "Principles of Psychology," Mr. Herbert Spencer appears to me to have brought out the essential truth which underlies Kant's doctrine in a far clearer manner than any one else; but, for the purpose of the present summary view of Hume's philosophy, it must suffice if I state the matter in my own way, giving the broad outlines, without entering into the details of a large and difficult discussion.

When a red light flashes across the field of vision, there arises in the mind an "impression of sensation"–which we call red. It appears to me that this sensation, red, is a something which may exist altogether independently of any other impression, or idea, as an individual existence. It is perfectly conceivable that a sentient being should have no sense but vision, and that he should have spent his existence in absolute darkness, with the exception of one solitary flash of red light. That momentary illumination would suffice to give him the impression under consideration. The whole content of his consciousness might be that impression; and, if he were endowed with memory, its idea.

[81] Such being the state of affairs, suppose a second flash of red light to follow the first. If there were no memory of the latter, the state of the mind on the second occasion would simply be a repetition of that which occurred before. There would be merely another impression.

But suppose memory to exist, and that an idea of the first impression is generated; then, if the supposed sentient being were like ourselves, there might arise in his mind two altogether new impressions. The one is the feeling of the *succession* of the two impressions, the other is the feeling of their *similarity.*

Yet a third case is conceivable. Suppose two flashes of red light to occur together, then a third feeling might arise which is neither succession nor similarity, but that which we call *co-existence.*

These feelings, or their contraries, are the foundation of everything that we call a relation. They are no more capable of being described than sensations are; and, as it appears to me, they are as little

susceptible of analysis into simpler elements. Like simple tastes and smells, or feelings of pleasure and pain, they are ultimate irresolvable facts of conscious experience; and, if we follow the principle of Hume's nomenclature, they must be called *impressions of relation* . But it must be remembered, that they differ from the [82] other impressions, in requiring the preexistence of at least two of the latter. Though devoid of the slightest resemblance to the other impressions, they are, in a manner, generated by them. In fact, we may regard them as a kind of impressions of impressions; or as the sensations of an inner sense, which takes cognizance of the materials furnished to it by the outer senses.

Hume failed as completely as his predecessors had done to recognise the elementary character of impressions of relation; and, when he discusses relations, he falls into a chaos of confusion and self-contradiction .

In the "Treatise," for example, (Book I., § iv.) resemblance, contiguity in time and space, and cause and effect, are said to be the "uniting principles among ideas," "the bond of union" or "associating quality by which one idea naturally introduces another." Hume affirms that–

"These qualities produce an association among ideas, and upon the appearance of one idea naturally introduce another." They are "the principles of union or cohesion among our simple ideas, and, in the imagination, supply the place of that inseparable connection by which they are united in our memory. Here is a kind of *attraction,* which, in the mental world, will be found to have as extraordinary effects as in the natural, and to show itself in as many and as various forms. Its effects are everywhere conspicuous; but, as to its causes they are mostly unknown, and must be resolved into *original* qualities of human nature, which I pretend not to explain."–(I. p. 29.)

[83] And at the end of this section Hume goes on to say–

"Amongst the effects of this union or association of ideas there are none more remarkable than those complex ideas which are the common subjects of our thought and reasoning, and generally arise from some principle of union among our simple ideas. These complex ideas may be resolved into *relations, modes,* and *substances* ." (*Ibid.*)

In the next section, which is devoted to *Relations,* they are spoken of as qualities ("by which two ideas are connected together in the imagination," or "which make objects admit of comparison," and seven kinds of relation are enumerated, namely, *resemblance, identity, space and time, quantity or number, degrees of quality, contrariety,* and *cause and effect.*

To the reader of Hume, whose conceptions are usually so clear, definite, and consistent, it is as unsatisfactory as it is surprising to meet with so much questionable and obscure phraseology in a small space. One and the same thing, for example, resemblance, is first called a "quality of an idea," and secondly a "complex idea." Surely it cannot be both. Ideas which have the qualities of "resemblance, contiguity, and cause and effect," are said to "attract one another" (save the mark!), and so become associated; though, in a subsequent part of the "Treatise," Hume's great effort is to prove that the relation of cause and effect is a particular case of the [84] process of association; that is to say, is a result of the

process of which it is supposed to be the cause. Moreover, since, as Hume is never weary of reminding his readers, there is nothing in ideas save copies of impressions, the qualities of resemblance, contiguity, and so on, in the idea, must have existed in the impression of which that idea is a copy; and therefore they must be either sensations or emotions–from both of which classes they are excluded.

In fact, in one place, Hume himself has an insight into the real nature of relations. Speaking of equality, in the sense of a relation of quantity. he says–

"Since equality is a relation, it is not, strictly speaking, a property in the figures themselves, but arises merely from the comparison which the mind makes between them."–(I. p. 70.)

That is to say, when two impressions of equal figures are present, there arises in the mind a *tertium quid,* which is the perception of equality. On his own principles, Hume should therefore have placed this "perception" among the ideas of reflection. However, as we have seen, he expressly excludes everything but the emotions and the passions from this group.

It is necessary therefore to amend Hume's primary "geography of the mind" by the excision of one territory and the addition of another; [85] and the elementary states of consciousness under consideration will stand thus:–

A. IMPRESSIONS.

A. Sensations of
a. Smell.
b. Taste.
c. Hearing.
d. Sight
e. Touch.
f. Resistance (the muscular sense).

B. Pleasure and Pain.
C. Relations.

a. Co-existence.
b. Succession.
c. Similarity and dissimilarity.

B. IDEAS.

Copies, or reproductions in memory, of the foregoing.

And now the question arises, whether any, and if so what, portion of these contents of the mind are to be

termed "knowledge?"

According to Locke, "Knowledge is the perception of the agreement or disagreement of two ideas;" and Hume, though he does not say so in so many words, tacitly accepts the definition. It follows, that neither simple sensation, nor simple emotion, constitutes knowledge; but that, when [86] impressions of relation are added to these impressions, or their ideas, knowledge arises; and that all knowledge is the knowledge of likenesses and unlikenesses, co-existences and successions.

It really matters very little in what sense terms are used, so long as the same meaning is always rigidly attached to them; and, therefore, it is hardly worth while to quarrel with this generally accepted, though very arbitrary, limitation of the signification of "knowledge." But, on the face of the matter, it is not obvious why the impression we call a relation should have a better claim to the title of knowledge, than that which we call a sensation or an emotion; and the restriction has this unfortunate result, that it excludes all the most intense states of consciousness from any claim to the title of "knowledge."

For example, on this view, pain, so violent and absorbing as to exclude all other forms of consciousness, is not knowledge; but becomes a part of knowledge the moment we think of it in relation to another pain, or to some other mental phenomenon. Surely this is somewhat inconvenient, for there is only a verbal difference between having a sensation and knowing one has it: they are simply two phrases for the same mental state.

But the "pure metaphysicians" make great capital out of the ambiguity. For, starting with the assumption that all knowledge is the perception of relations, and finding themselves like [87] mere common-sense folks, very much disposed to call sensation knowledge, they at once gratify that disposition and save their consistency, by declaring that even the simplest act of sensation contains, two terms and a relation–the sensitive subject the sensigenous object, and that masterful entity, the Ego. From which great triad, as from a gnostic Trinity, emanates an endless procession of other logical shadows and all the *Fata Morgana* of philosophical dreamland.

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[1] "Consciousnesses" would be a better name, but it is awkward. I have elsewhere proposed *psychoses* as a substantive name for mental phenomena.

[2] As this has been denied, it may be as well to give Descartes's words: Par le mot de penser, j'entends tout ce que se fait dans nous de telle sorte que nous l'apercevons immédiatement par nousmêmes: c'est pourquoi non-seulement entendre, vouloir, imaginer, mais aussi sentir, c'est le même chose ici que pense."–Principes de Philosophie. Ed. Cousin, 57.

"Toutes les propriétés que nous trouvons en la chose qui pense ne sont que des façons differentes de penser. "–*Ibid* . 96.

[3] On the whole, it is pleasant to find satisfactory evidence that Hume knew nothing of the works of Spinoza; for the invariably abusive manner in which he refers to that type of the philosophic hero is only to be excused, if it is to be excused, by sheer ignorance of his life and work.

[4] For example, in discussing pride and humility, Hume says

"According as our idea of ourselves is more or less advantageous, we feel either of these opposite affections, and are elated by pride or dejected with humility . . . when self enters not into the consideration there is no room either for pride or humility." That is, pride is pleasure, and humility is pain, associated with certain conceptions of one's self; or as Spinoza puts it:–"Superbia est de se præ amore sui plus justo sentire." ("amor" being "lætitia concomitante idea causæ externæ"); and "Humilitas est tristitia orta ex eo quod homo suam impotentiam sive imbecillitatem contemplatur."

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[88] Chapter III

The Origin of the Impressions

Admitting that the sensations, the feelings of pleasure and pain, and those of relation, are the primary irresolvable states of consciousness, two further lines of investigation present themselves. The one leads us to seek the origin of these "impressions:" the other, to inquire into the nature of the steps by which they become metamorphosed into those compound states of consciousness, which so largely enter into our ordinary trains of thought.

With respect to the origin of impressions of sensation, Hume is not quite consistent with himself. In one place (I. p. 117) he says, that it is impossible to decide "whether they arise immediately from the object, or are produced by the creative power of the mind, or are derived from the Author of our being," thereby implying that realism and idealism are equally probable hypotheses. But, in fact, after the demonstration by Descartes, that [89] the immediate antecedents of sensations are changes in the nervous system, with which our feelings have no sort of resemblance, the hypothesis that sensations "arise immediately from the object" was out of court; and that Hume fully admitted the Cartesian doctrine is apparent when he says (I. p. 272):–

"All our perceptions are dependent on our organs and the disposition of our nerves and animal spirits."

And again, though in relation to another question, he observes:–

"There are three different kinds of impressions conveyed by the senses. The first are those of the figure, bulk, motion and solidity of bodies. The second those of colours, tastes smells, sounds, heat, and cold. The third are the pains and pleasures that arise from the application of objects to our bodies, as by the cutting of our flesh with steel, and such like. Both philosophers and the vulgar suppose the first of these to have a distinct continued existence. The vulgar only regard the second as on the same footing. Both philosophers and the vulgar again esteem the third to be merely perceptions, and consequently interrupted and dependent beings.

"Now 'tis evident that, whatever may be our philosophical opinion, colour, sounds, heat, and cold, as far as appears to the senses, exist after the same manner with motion and solidity; and that the difference we make between them, in this respect, arises not from the mere perception. So strong is the prejudice for the distinct continued existence of the former qualities, that when the contrary opinion is advanced by modern philosophers, people imagine they can almost refute it from their reason and experience, and that their very senses contradict this philosophy. 'Tis also evident that colours, sounds, &c., are originally on the same footing with the pain that arises from steel, and pleasure that proceeds from [90] a fire; and that the difference betwixt them is founded neither on perception nor reason, but on the imagination. For as they are confessed to be, both of them, nothing but perceptions arising from the particular configurations and motions of the parts of the body, wherein possibly can their difference consist? Upon the whole then, we may conclude that, as far as the senses are judges all perceptions are the same in the manner of their existence."–(I. p. 250, 251.)

The last words of this passage are as much Berkeley's as Hume's. But, instead of following Berkeley in his deductions from the position thus laid down, Hume, as the preceding citation shows, fully adopted the conclusion to which all that we know of psychological physiology tends, that the origin of the elements of consciousness, no less than that of all its other states, is to be sought in bodily changes, the seat of which can only be placed in the brain. And, as Locke had already done with less effect, he states and refutes the arguments commonly brought against the possibility of a causal connection between the modes of motion of the cerebral substance and states of consciousness, with great clearness:–

"From these hypotheses concerning the *substance* and *local conjunction* of our perceptions we may pass to another, which is more intelligible than the former, and more important than the latter, viz. concerning the *cause* of our perceptions. Matter and motion, 'tis commonly said in the schools, however varied, are still matter and motion, and produce only a difference in the position and situation of objects. Divide a body as often as you please, 'tis still body. Place it in any figure, nothing ever results but figure, or the relation of parts. Move it in any [91] manner, you still find motion or a change of relation. 'Tis absurd to imagine that motion in a circle, for instance, should be nothing but merely motion in a circle; while motion in another direction, as in an ellipse, should also be a passion or moral reflection; that the shocking of two globular particles should become a sensation of pain, and that the meeting of the triangular ones should afford a pleasure. Now as these different shocks and variations and mixtures are the only changes of which matter is susceptible, and as these never afford us any idea of thought or perception, 'tis concluded to be impossible, that thought can ever be caused by matter.

"Few have been able to withstand the seeming evidence of this argument; and yet nothing in the world is more easy than to refute it. We need only reflect upon what has been proved at large, that we are never sensible of any connection between causes and effects, and that 'tis only by our experience of their constant conjunction we can arrive at any knowledge of this relation. Now, as all objects which are not contrary are susceptible of a constant conjunction, and as no real objects are contrary, I have inferred from these principles (Part III. § 16) that, to consider the matter *a priori*, anything may produce anything, and that we shall never discover a reason why any object may or may not be the cause of any other, however great, or however little, the resemblance may be betwixt them. This evidently destroys the precedent reasoning, concerning the cause of thought or perception. For though there appear no manner of connection betwixt motion and thought, the case is the same with all other causes and effects. Place one body of a pound weight on one end of a lever, and another body of the same weight on the other end; you will never find in these bodies any principle of motion dependent on their distance from the centre, more than of thought and perception. If you pretend, therefore, to prove, *a priori*, that such a position of

bodies can never cause thought, because, turn it which way you will, it is nothing but a position of bodies: you must, by the same course of reasoning, conclude that it can never produce motion, since there is no more apparent connection in the one than in the other.

[92] But, as this latter conclusion is contrary to evident experience, and as 'tis possible we may have a like experience in the operations of the mind, and may perceive a constant conjunction of thought and motion, you reason too hastily when, from the mere consideration of the ideas, you conclude that 'tis impossible motion can ever produce thought, or a different position of parts give rise to a different passion or reflection. Nay, 'tis not only possible we may have such an experience, but 'tis certain we have it; since every one may perceive that the different dispositions of his body change his thoughts and sentiments. And should it be said that this depends on the union of soul and body, I would answer, that we must separate the question concerning the substance of the mind from that concerning the cause of its thought; and that, confining ourselves to the latter question, we find, by the comparing their ideas, that thought and motion are different from each other, and by experience that they are constantly united; which, being all the circumstances that enter into the idea of cause and effect, when applied to the operations of matter, we may certainly conclude that motion may be, and actually is, the cause of thought and perception."–(I. pp. 314–316.)

The upshot of all this is, that the "collection of perceptions," which constitutes the mind, is really a system of effects, the causes of which are to be sought in antecedent changes of the matter of the brain, just as the "collection of motions," which we call flying, is a system of effects, the causes of which are to be sought in the modes of motion of the matter of the muscles of the wings.

Hume, however, treats of this important topic only incidentally. He seems to have had very little acquaintance even with such physiology as was current in his time. At least, the only passage of his works, bearing on this subject, with which I [93] am acquainted, contains nothing but a very odd version of the physiological views of Descartes–

"When I received the relations of *resemblance, contiguity,* and *causation,* as principles of union among ideas, without examining into their causes, 'twas more in prosecution of my first maxim, that we must in the end rest contented with experience, than for want of something specious and plausible which I might have displayed on that subject. 'Twould have been easy to have made an imaginary dissection of the brain, and have shown why, upon our conception of any idea, the animal spirits run into all the contiguous traces and rouse up the other ideas that are related to it. But though I have neglected any advantage which I might have drawn from this topic in explaining the relations of ideas, I am afraid I must here have recourse to it, in order to account for the mistakes that arise from these relations. I shall therefore observe, that as the mind is endowed with the power of exciting any idea it pleases; whenever it despatches the spirits into that region of the brain in which the idea is placed; these spirits always excite the idea, when they run precisely into the proper traces and rummage that cell which belongs to the idea. But as their motion is seldom direct, and naturally turns a little to the one side or to the other; for this reason the animal spirits, falling into the contiguous traces, present other related ideas, in lieu of that which the mind desired at first to survey. This change we are not always sensible of; but continuing still the same train of thought, make use of the related idea which is presented to us and employ it in our reasonings, as if it were the same with what we demanded. This is the cause of many mistakes and sophisms in philosophy; as will naturally be imagined, and as it would be easy to show, if there was occasion." (I. p. 88.)

Perhaps it is as well for Hume's fame that the occasion for further physiological speculations of this sort

did not arise. But, while admitting the [94] crudity of his notions and the strangeness of the language in which they are couched, it must in justice be remembered, that what are now known as the elements of the physiology of the nervous system were hardly dreamed of in the first half of the eighteenth century; and, as a further set off to Hume's credit, it must be noted that he grasped the fundamental truth, that the key to the comprehension of mental operations lies in the study of the molecular changes of the nervous apparatus by which they are originated.

Surely no one who is cognisant of the facts of the case, nowadays, doubts that the roots of psychology lie in the physiology of the nervous system. What we call the operations of the mind are functions of the brain, and the materials of consciousness are products of cerebral activity. Cabanis may have made use of crude and misleading phraseology when he said that the brain secretes thought as the liver secretes bile; but the conception which that much-abused phrase embodies is, nevertheless, far more consistent with fact than, the popular notion that the mind is a metaphysical entity seated in the head, but as independent of the brain as a telegraph operator is of his instrument.

It is hardly necessary to point out that the doctrine just laid down is what is commonly called materialism. In fact, I am not sure that the adjective "crass," which appears to have a [95] special charm for rhetorical sciolists, would not be applied to it. But it is, nevertheless, true that the doctrine contains nothing inconsistent with the purest idealism. For, as Hume remarks (as indeed Descartes had observed long before):–

"'Tis not our body we perceive when we regard our limbs and members, but certain impressions which enter by the senses; so that the ascribing a real and corporeal existence to these impressions, or to their object, is an act of the mind as difficult to explain as that [the external existence of objects] which we examine at present." (I. p. 249.)

Therefore, if we analyse the proposition that all mental phenomena are the effects or products of material phenomena, all that it means amounts to this: that whenever those states of consciousness which we call sensation, or emotion, or thought, come into existence, complete investigation will show good reason for the belief that they are preceded by those other phenomena of consciousness to which we give the names of matter and motion. All material changes appear, in the long run, to be modes of motion; but our knowledge of motion is nothing but that of a change in the place and order of our sensations; just as our knowledge of matter is restricted to those feelings of which we assume it to be the cause.

It has already been pointed out, that Hume must have admitted, and in fact does admit, the possibility that the mind is a Leibnitzian monad, or a Fichtean world-generating Ego, the universe [96] of things being merely the picture produced by the evolution of the phenomena of consciousness. For any demonstration that can be given to the contrary effect, the "collection of perceptions" which makes up our consciousness maybe an orderly phantasmagoria generated by the Ego, unfolding its successive scenes on the background of the abyss of nothingness; as a firework, which is but cunningly arranged combustibles, grows from a spark into a coruscation, and from a coruscation into figures, and words, and cascades of devouring fire, and then vanishes into the darkness of the night.

On the other hand, it must no less readily be allowed that, for anything that can be proved to the contrary, there may be a real something which is the cause of all our impressions; that sensations, though not likenesses, are symbols of that something; and that the part of that something, which we call the nervous system, is an apparatus for supplying us with a sort of algebra of fact, based on those symbols. A brain may be the machinery by which the material universe becomes conscious of itself. But it is important to notice that, even if this conception of the universe and of the relation of consciousness to its other components should be true, we should, nevertheless, be still bound by the limits of thought, still unable to refute the arguments of pure idealism. The more completely the material[97]istic position is admitted, the easier is it to show that the idealistic position is unassailable, if the idealist confines himself within the limits of positive knowledge.

Hume deals with the questions whether all our ideas are derived from experience, or whether, on the contrary, more or fewer of them are innate, which so much exercised the mind of Locke, after a somewhat summary fashion, in a note to the second section of the "Inquiry":–

"It is probable that no more was meant by those who denied innate ideas, than that all ideas were copies of our impressions; though it must be confessed that the terms which they employed were not chosen with such caution, nor so exactly defined, as to prevent all mistakes about their doctrine. For what is meant by *innate*? If innate be equivalent to natural, then all the perceptions and ideas of the mind must be allowed to be innate or natural, in whatever sense we take the latter word, whether in opposition to what is uncommon, artificial, or miraculous. If by innate be meant contemporary with our birth, the dispute seems to be frivolous; nor is it worth while to inquire at what time thinking begins, whether before, at, or after our birth. Again, the word *idea* seems to be commonly taken in a very loose sense by Locke and others, as standing for any of our perceptions, our sensations and passions, as well as thoughts. Now in this sense I should desire to know what can be meant by asserting that self-love, or resentment of injuries, or the passion between the sexes is not innate?

"But admitting these terms, *impressions* and *ideas,* in the sense above explained, and understanding by *innate* what is original or copied from no precedent perception, then we may assert that all our impressions are innate, and our ideas not innate."

It would seem that Hume did not think it worth while to acquire a comprehension of the [98] real points at issue in the controversy which he thus carelessly dismisses.

Yet Descartes has defined what he means by innate ideas with so much precision, that misconception ought to have been impossible. He says that, when he speaks of an idea being "innate," he means that it exists potentially in the mind, before it is actually called into existence by whatever is its appropriate exciting cause.

"I have never either thought or said," he writes, "that the mind has any need of innate ideas [*idées naturelles*] which are anything distinct from its faculty of thinking. But it is true that observing that there are certain thoughts which arise neither from external objects nor from the determination of my will, but only from my faculty of thinking; in order to mark the difference between the ideas or the notions which are the forms of these thoughts, and to distinguish them from the others, which may be called extraneous or voluntary, I have called them innate.

But I have used this term in the same sense as when we say that generosity is innate in certain families; or that certain maladies, such as gout or gravel, are innate in others; not that children born in these families are troubled with such diseases in their mother's womb; but because they are born with the disposition or the faculty of contracting them."[1]

His troublesome disciple, Regius, having asserted that all our ideas come from observation or tradition, Descartes remarks:–

"So thoroughly erroneous is this assertion, that whoever has a proper comprehension of the action of our senses, and under[99]stands precisely the nature of that which is transmitted by them to our thinking faculty, will rather affirm that no ideas of things, such as are formed in thought, are brought to us by the senses, so that there is nothing in our ideas which is other than innate in the mind (*naturel à l'espirit*), or in the faculty of thinking, if only certain circumstances are excepted, which belong only to experience. For example, it is experience alone which causes us to judge that such and such ideas, now present in our minds are related to certain things which are external to us; not, in truth, that they have been sent into our mind by these things, such as they are, by the organs of the senses; but because these organs have transmitted something which has occasioned the mind, in virtue of its innate power, to form them at this time rather than at another.....

"Nothing passes from external objects to the soul except certain motions of matter (*movemens corporels*), but neither these motions, nor the figures which they produce, are conceived by us as they exist in the sensory organs, as I have fully explained in my 'Dioptrics'; whence it follows that even the ideas of motion and of figures are innate (*naturellement en nous*). And, *a fortiori*, the ideas of pain, of colours, of sounds, and of all similar things must be innate, in order that the mind may represent them to itself, on the occasion of certain motions of matter with which they have no resemblance."

Whoever denies what is, in fact, an inconceivable proposition, that sensations pass, as such, from the external world into the mind, must admit the conclusion here laid down by Descartes, that, strictly speaking, sensations, and *a fortiori*, all the other contents of the mind, are innate. Or, to state the matter in accordance with the views previously expounded, that they are products of the inherent properties of the thinking organ, in which they lie potentially, before they are called into existence by their appropriate causes.

[100] But if all the contents of the mind are innate, what is meant by experience?

It is the conversion, by unknown causes, of these innate potentialities into actual existences. The organ of thought, prior to experience, may be compared to an untouched piano, in which it may be properly said that music is innate, inasmuch as its mechanism contains, potentially, so many octaves of musical notes. The unknown cause of sensation which Descartes calls the "je ne sais quoi dans les objets" or "choses telles qu'elles sont," and Kant the "Noumenon" or "Ding an sich," is represented by the musician; who, by touching the keys, converts the potentiality of the mechanism into actual sounds. A note so produced is the equivalent of a single experience.

All the melodies and harmonies that proceed from the piano depend upon the action of the musician

upon the keys. There is no internal mechanism which, when certain keys are struck, gives rise to an accompaniment of which the musician is only indirectly the cause. According to Descartes, however–and this is what is generally fixed upon as the essence of his doctrine of innate ideas–the mind possesses such an internal mechanism, by which certain classes of thoughts are generated, on the occasion of certain experiences. Such thoughts are innate, just as sensations are innate; they are not copies of sensations, any more than sensations are copies of motions; they are [101] invariably generated in the mind, when certain experiences arise in it, just as sensations are invariably generated when certain bodily motions take place; they are universal, inasmuch as they arise under the same conditions in all men; they are necessary, because their genesis under these conditions is invariable. These innate thoughts are what Descartes terms "vérités" or truths: that is beliefs–and his notions respecting them are plainly set forth in a passage of the "Principes."

"Thus far I have discussed that which we know as things: it remains that I should speak of that which we know as truths. For example, when we think that it is impossible to make anything out of nothing, we do not imagine that this proposition is a thing which exists, or a property of something, but we take it for a certain eternal truth, which has its seat in the mind (*pensee*), and is called a common notion or an axiom. Similarly, when we affirm that it is impossible that one and the same thing should exist and not exist at the same time; that that which has been created should not have been created; that he who thinks must exist while he thinks; and a number of other like propositions; these are only truths, and not things which exist outside our thoughts. And there is such s number of these that it would be wearisome to enumerate them: nor is it necessary to do so, because we cannot fail to know them when the occasion of thinking about them presents itself, and we are not blinded by any prejudices."

It would appear that Locke was not more familiar with Descartes' writings than Hume seems to have been; for, viewed in relation to the passages just cited, the arguments adduced in [102] his famous polemic against innate ideas are totally irrelevant.

It has been shown that Hume practically, if not in so many words, admits the justice of Descartes' assertion that, strictly speaking, sensations are innate; that is to say, that they are the product of the reaction of the organ of the mind on the stimulus of an "unknown cause," which is Descartes' "je ne sais quoi." Therefore, the difference between Descartes' opinion and that of Hume resolves itself into this: Given sensation-experiences, can all the contents of consciousness be derived from the collocation and metamorphosis of these experiences? Or, are new elements of consciousness, products of an innate potentiality distinct from sensibility, added to these? Hume affirms the former position, Descartes the latter. If the analysis of the phenomena of consciousness given in the preceding pages is correct, Hume is in error; while the father of modern philosophy had a truer insight, though he overstated the case. For want of sufficiently searching psychological investigations, Descartes was led to suppose that innumerable ideas, the evolution of which in the course of experience can be demonstrated, were direct or innate products of the thinking faculty.

As has been already pointed out, it is the great merit of Kant that he started afresh on the track indicated by Descartes, and steadily upheld the doctrine of the existence of elements of conscious[103]ness, which are neither sense-experiences nor any modifications of them. We may demur to the expression that space

and time are forms of sensory intuition; but it imperfectly represents the great fact that co-existence and succession are mental phenomena not given in the mere sense experience.[2]

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[1] Remarques de René Descartes sur un certain placard imprimé aux Pays Bas vers la fin de l'année, 1647.–Descartes, *Œuevres* . Ed. Cousin, x. p. 71.

[2] "Wir konnen uns keinen Gegenstand denken, ohne durch Kategorien, wir können keinen gedachten Gegenstand erkennen, ohne durch Anschauungen, die jenen Begriffen entsprechen. Nun sind alle unsere Anschauungen sinnlich, und diese Erkenntniss, so fern der Gegenstand derselben gegeben ist, ist empirisch. Empirische Erkenntniss aber ist Erfahrung. Folglich ist uns keine Erkenntniss *a priori* moglich, als lediglich von Gegenstanden möglicher Erfahrung."

"Aber diese Erkenntniss, die bloss auf Gegenstände der Erfahrung eingeschrankt ist, ist darum nicht alle von der Erfahrung entlehnt, sondern was sowohl die reinen Anschauungen, als die reinen Verstandesbegriffe betrifft, so sind sie Elemente der Erkenntniss die in uns *a priori* angetroffen werden." –*Kritik der reinen Vernunft. Elementarlehre* p. 135.

Without a glossary explanatory of Kant's terminology, this passage would be hardly intelligible in a translation; but it may be paraphrased thus: All knowledge is founded upon experiences of sensation, but it is not all derived from those experiences; inasmuch as the impressions of relation ("reine Anschauungen", "reine Verstandesbegriffe") have a potential or *a priori* existence in us, and by their addition to sense-experiences, constitute knowledge.

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[104] Chapter IV

The Classification and the Nomenclature of Mental Operations

If, as has been set forth in the preceding chapter, all mental states are effects of physical causes, it follows that what are called mental faculties and operations are, properly speaking, cerebral functions, allotted to definite, though not yet precisely assignable, parts of the brain.

These functions appear to be reducible to three groups, namely: Sensation, Correlation, and Ideation.

The organs of the functions of sensation and correlation are those portions of the cerebral substance, the molecular changes of which give rise to impressions of sensation and impressions of relation.

The changes in the nervous matter which bring about the effects which we call its functions, follow upon some kind of stimulus, and rapidly reaching their maximum, as rapidly die away. The effect of the irritation of a nerve-fibre on the cerebral substance with which it is connected may be com[105]pared to

the pulling of a long bell-wire. The impulse takes a little time to reach the bell; the bell rings and then becomes quiescent, until another pull is given. So, in the brain, every sensation is the ring of a cerebral particle, the effect of a momentary impulse sent along a nerve-fibre.

If there were a complete likeness between the two terms of this very rough and ready comparison, it is obvious that there could be no such thing as memory. A bell records no audible sign of having been rung five minutes ago, and the activity of a sensigenous cerebral particle might similarly leave no trace. Under these circumstances, again, it would seem that the only impressions of relation which could arise would be those of co-existence and of similarity. For succession implies memory of an antecedent state.[1]

But the special peculiarity of the cerebral apparatus is, that any given function which has once been performed is very easily set a-going again, by causes more or less different from those to which it owed its origin. Of the mechanism of this generation of images of impressions or ideas (in Hume's sense), which may be termed *Ideation*, we know nothing at present, though the fact and its results are familiar enough.

[106] During our waking, and many of our sleeping, hours, in fact, the function of ideation is in continual, if not continuous, activity. Trains of thought, as we call them, succeed one another without intermission, even when the starting of new trains by fresh sense-impressions is as far as possible prevented. The rapidity and the intensity of this ideational process are obviously dependent upon physiological conditions. The widest differences in these respects are constitutional in men of different temperaments; and are observable in oneself, under varying conditions of hunger and repletion, fatigue and freshness, calmness and emotional excitement. The influence of diet on dreams; of stimulants upon the fulness and the velocity of the stream of thought; the delirious phantasms generated by disease, by hashish, or by alcohol; will occur to every one as examples of the marvellous sensitiveness of the apparatus of ideation to purely physical influences.

The succession of mental states in ideation is not fortuitous, but follows the law of association, which may be stated thus: that every idea tends to be followed by some other idea which is associated with the first, or its impression, by a relation of succession, of contiguity, or of likeness.

Thus the idea of the word horse just now presented itself to my mind, and was followed in quick succession by the ideas of four legs, hoofs, teeth, rider, saddle, racing, cheating; all of which [107] ideas are connected in my experience with the impression, or the idea, of a horse and with one another, by the relations of contiguity and succession. No great attention to what passes in the mind is needful to prove that our trains of thought are neither to be arrested, nor even permanently controlled, by our desires or emotions. Nevertheless they are largely influenced by them. In the presence of a strong desire, or emotion, the stream of thought no longer flows on in a straight course, but seems, as it were, to eddy round the idea of that which is the object of the emotion. Every one who has "eaten his bread in sorrow" knows how strangely the current of ideas whirls about the conception of the object of regret or remorse as a centre; every now and then, indeed, breaking away into the new tracts suggested by passing associations, but still returning to the central thought, Few can have been so happy as to have escaped

the social bore, whose pet notion is certain to crop up whatever topic is started; while the fixed idea of the monomaniac is but the extreme form of the same phenomenon.

And as, on the one hand, it is so hard to drive away the thought we would fain be rid of; so, upon the other, the pleasant imaginations which we would so gladly retain are, sooner or later, jostled away by the crowd of claimants for birth into the world of consciousness; which hover as a sort of psychical possibilities, or inverse ghosts, [108] the bodily presentments of spiritual phenomena to be, in the limbo of the brain. In that form of desire which is called "attention," the train of thought held fast, for a time, in the desired direction, seems ever striving to get on to another line–and the junctions and sidings are so multitudinous!

The constituents of trains of ideas may be grouped in various ways.

Hume says:–

"We find, by experience, that when any impression has been present in the mind, it again makes its appearance there as an idea, and this it may do in two different ways: either when, on its new appearance, it retains a considerable degree of its first vivacity, and is somewhat intermediate between an impression and an idea; or when it entirely loses that vivacity, and is a perfect idea. The faculty by which we repeat our impressions in the first manner; is called the *memory,* and the other the *imagination* "–I pp. 23, 24.)

And he considers that the only difference between ideas of imagination and those of memory, except the superior vivacity of the latter, lies in the fact that those of memory preserve the original order of the impressions from which they are derived, while the imagination "is free to transpose and change its ideas."

The latter statement of the difference between memory and imagination is less open to cavil than the former, though by no means unassailable.

The special characteristic of a memory surely is not its vividness; but that it is a complex idea, in [109] which the idea of that which is remembered is related by co-existence with other ideas, and by antecedence with present impressions.

If I say I remember A. B., the chance acquaintance of ten years ago, it is not because my idea of A. B. is very vivid–on the contrary, it is extremely faint–but because that idea is associated with ideas of impressions co-existent with those which I call A. B.; and that all these are at the end of the long series of ideas, which represent that much past time. In truth I have a much more vivid idea of Mr. Pickwick, or of Colonel Newcome, than I have of A. B.; but, associated with the ideas of these persons, I have no idea of their having ever been derived from the world of impressions; and so they are relegated to the world of imagination. On the other hand, the characteristic of an imagination may properly be said to lie not in its intensity, but in the fact, that as Hume puts it, "the arrangement," or the relations, of the ideas are different from those in which the impressions, whence these ideas are derived, occurred; or in other

words, that the thing imagined has not happened. In popular usage, however, imagination is frequently employed for simple memory–"In imagination I was back in the old times."

It is a curious omission on Hume's part that while thus dwelling on two classes of ideas, *Memories* and *Imaginations,* he has not, at the [110] same time, taken notice of a third group, of no small importance, which are as different from imaginations as memories are; though, like the latter, they are often confounded with pure imaginations in general speech. These are the ideas of expectation, or as they may be called for the sake of brevity, *Expectations;* which differ from simple imaginations in being associated with the idea of the existence of corresponding impressions, in the future, just as memories contain the idea of the existence of the corresponding impressions in the past.

The ideas belonging to two of the three groups enumerated: namely, memories and expectations, present some features of particular interest. And first, with respect to memories.

In Hume's words, all simple ideas are copies of simple impressions. The idea of a single sensation is a faint, but accurate, image of that sensation; the idea of a relation is a reproduction of the feeling of co-existence, of succession, or of similarity. But, when complex impressions or complex ideas are reproduced as memories, it is probable that the copies never give all the details of the originals with perfect accuracy, and it is certain that they rarely do so. No one possesses a memory so good, that if he has only once observed a natural object, a second inspection does not show him something that he has forgotten. Almost all, if not all, our memories are therefore [111] sketches, rather than portraits, of the original–the salient features are obvious, while the subordinate characters are obscure or unrepresented.

Now, when several complex impressions which are more or less different from one another–let us say that out of ten impressions in each, six are the same in all, and four are different from all the rest–are successively presented to the mind, it is easy to see what must be the nature of the result. The repetition of the six similar impressions will strengthen the six corresponding elements of the complex idea, which will therefore acquire greater vividness; while the four differing impressions of each will not only acquire no greater strength than they had at first, but, in accordance with the law of association, they will all tend to appear at once, and will thus neutralise one another.

This mental operation may be rendered comprehensible by considering what takes place in the formation of compound photographs–when the images of the faces of six sitters, for example, are each received on the same photographic plate, for a sixth of the time requisite to take one portrait. The final result is that all those points in which the six faces agree are brought out strongly, while all those in which they differ are left vague; and thus what may be termed a *generic* portrait of the six, in contradistinction to a *specific* portrait of any one, is produced.

[112] Thus our ideas of single complex impressions are incomplete in one way, and those of numerous, more or less similar, complex impressions are incomplete in another way; that is to say, they are *generic,* not *specific.* And hence it follows, that our ideas of the impressions in question are not, in the strict sense of the word, copies of those impressions; while at the same time, they may exist in the mind

independently of language.

The generic ideas which are formed from several similar, but not identical, complex experiences are what are commonly called *abstract* or *general* ideas; and Berkeley endeavoured to prove that all general ideas are nothing but particular ideas annexed to a certain term, which gives them a more extensive signification, and makes them recall, upon occasion, other individuals which are similar to them. Hume says that he regards this as "one of the greatest and the most valuable discoveries that has been made of late years in the republic of letters," and endeavours to confirm it in such a manner that it shall be "put beyond all doubt and controversy."

I may venture to express a doubt whether he has succeeded in his object; but the subject is an abstruse one; and I must content myself with the remark, that though Berkeley's view appears to be largely applicable to such general ideas as are formed after language has been acquired, and to all the more abstract [113] sort of conceptions, yet that general ideas of sensible objects may nevertheless be produced in the way indicated, and may exist independently of language. In dreams, one sees houses, trees and other objects, which are perfectly recognisable as such, but which remind one of the actual objects as seen "out of the corner of the eye," or of the pictures thrown by a badly-focused magic lantern. A man addresses us who is like a figure seen by twilight; or we travel through countries where every feature of the scenery is vague; the outlines of the hills are ill-marked, and the rivers have no defined banks. They are, in short, generic ideas of many past impressions of men, hills, and rivers. An anatomist who occupies himself intently with the examination of several specimens of some new kind of animal, in course of time acquires so vivid a conception of its form and structure, that the idea may take visible shape and become a sort of waking dream. But the figure which thus presents itself is generic, not specific. It is no copy of any one specimen, but, more or less, a mean of the series; and there seems no reason to doubt that the minds of children before they learn to speak, and of deaf mutes, are people with similarly generated generic ideas of sensible objects.

It has been seen that a memory is a complex idea made up of at least two constituents. In the [114] first place there is the idea of an object; and secondly, there is the idea of the relation of antecedents between that object and some present objects.

To say that one has a recollection of a given event and to express the belief that it happened, are two ways of giving an account of one and the same mental fact. But the former mode of stating the fact of memory is preferable, at present, because it certainly does not presuppose the existence of language in the mind of the rememberer; while it may be said that the latter does. It is perfectly possible to have the idea of an event A, and of the events B, C, D, which came between it and the present state E, as mere mental pictures. It is hardly to be doubted that children have very distinct memories long before they can speak; and we believe that such is the case because they act upon their memories. But, if they act upon their memories, they to all intents and purposes believe their memories. In other words, though, being devoid of language, the child cannot frame a proposition expressive of belief; cannot say "sugar-plum was sweet"; yet the physical operation of which that proposition is merely the verbal expression, is perfectly effected. The experience of the co-existence of sweetness with sugar has produced a state of mind which bears the same relation to a verbal proposition, as the natural disposition to produce a given

idea, assumed to exist by [115] Descartes as an "innate idea" would bear to that idea put into words.

The fact that the beliefs of memory precede the use of language, and therefore are originally purely instinctive, and independent of any rational justification, should have been of great importance to Hume, from its bearing upon his theory of causation; and it is curious that he has not adverted to it, but always takes the trustworthiness of memories for granted. It may be worth while briefly to make good the omission.

That I was in pain, yesterday, is as certain to me as any matter of fact can be; by no effort of the imagination is it possible for me really to entertain the contrary belief. At the same time, I am bound to admit, that the whole foundation for my belief is the fact, that the idea of pain is dissolubly associated in my mind with the idea of that much past time. Any one who will be at the trouble may provide himself with hundreds of examples to the same effect.

This and similar observations are important under another aspect. They prove that the idea of even a single strong impression may be so powerfully associated with that of a certain time, as to originate a belief of which the contrary is inconceivable, and which may therefore be properly said to be necessary. A single weak, or moderately strong, impression may not be represented by any memory. But this defect of weak [116] experiences may be compensated by their repetition; and what Hume means by "custom" or "habit" is simply the repetition of experiences.

"Whenever the repetition of any particular act or operation produces a propensity to renew the same act or operation, without being impelled by any reasoning or process of the understanding, we always say that this propensity is the effect of *Custom* . By employing that word, we pretend not to have given the ultimate reason of such a propensity. We only point out a principle of human nature which is universally acknowledged, and which is well known by its effects."–(IV. p. 52.)

It has been shown that an expectation is a complex idea which, like a memory, is made up of two constituents. The one is the idea of an object, the other is the idea of a relation of sequence between that object and some present object; and the reasoning which applied to memories applies to expectations. To have an expectation[2] of a given event, and to believe that it will happen, are only two modes of stating the same fact. Again, just in the same way as we call a memory, put into words, a belief, so we give the same name to an expectation in like clothing. And the fact already cited, that a child before it can speak acts upon its memories, is good evidence that it forms expectations. The infant who knows the meaning neither of "sugar-plum" nor [117] of "sweet," nevertheless is in full possession of that complex idea, which, when he has learned to employ language, will take the form of the verbal proposition, "A sugar-plum will be sweet."

Thus, beliefs of expectation, or at any rate their potentialities, are, as much as those of memory, antecedent to speech, and are as incapable of justification by any logical process. In fact, expectations are but memories inverted. The association which is the foundation of expectation must exist as a memory before it can play its part. As Hume says,–

". . . it is certain we here advance a very intelligible proposition at least, if not a true one, when we assert that after the constant conjunction of two objects, heat and flame, for instance, weight and solidity, we are determined by custom alone to expect the one from the appearance of the other. This hypothesis seems even the only one which explains the difficulty why we draw from a thousand instances, an inference which we are not able to draw from one instance, that is in no respect different from them." . . .

"Custom, then, is the great guide of human life. It is that principle alone which renders our experience useful to us, and makes us expect, for the future, a similar train of events with those which have appeared in the past." . . .

"All belief of matter-of-fact or real existence is derived merely from some object present to the memory or senses, and a customary conjunction between that and some other object, or in other words, having found, in many instances, that any two kinds of objects, flame and heat, snow and cold, have always been conjoined together, if flame or snow be presented anew to the senses, the mind is carried by custom to expect heat or cold, and to *believe* that such a quality does exist and will discover itself upon a nearer approach. This belief is the necessary result [118] of placing the mind in such circumstances. It is an operation of the soul, when we are so situated, as unavoidable as to feel the passion of love, when we receive benefits, or hatred, when we meet with injuries. All these operations are a species of natural instincts, which no reasoning or process of the thought and understanding is able either to produce or to prevent."–(IV. pp. 52–56.)

The only comment that appears needful here is, that Hume has attached somewhat too exclusive a weight to that repetition of experiences to which alone the term "custom" can be properly applied. The proverb says that "a burnt child dreads the fire"; and any one who will make the experiment will find, that one burning is quite sufficient to establish an indissoluble belief that contact with fire and pain go together.

As a sort of inverted memory, expectation follows the same laws; hence, while a belief of expectation is, in most cases, as Hume truly says, established by custom, or the repetition of weak impressions, it may quite well be based upon a single strong experience. In the absence of language, a specific memory cannot be strengthened by repetition. It is obvious that that which has happened cannot happen again, with the same collateral associations of co-existence and succession. But, memories of the co-existence and succession of impressions are capable of being indefinitely strengthened by the recurrence of similar impressions, in the same order, even though the collateral associations are totally [119] different; in fact, the ideas of these impressions become generic.

If I recollect that a piece of ice was cold yesterday, nothing can strengthen the recollection of that particular fact; on the contrary, it may grow weaker, in the absence of any record of it. But if I touch ice to-day and again find it cold, the association is repeated, and the memory of it becomes stronger. And by this very simple process of repetition of experience, it has become utterly impossible for us to think of having handled ice without thinking of its coldness. But, that which is, under the one aspect, the strengthening of a memory, is, under the other, the intensification of an expectation. Not only can we not think of having touched ice, without feeling cold, but we cannot think of touching ice, in the future, without expecting to feel cold. An expectation so strong that it cannot be changed, or abolished, may thus be generated out of repeated experiences. And it is important to note that such expectations may be

formed quite unconsciously. In my dressing-room, a certain can is usually kept full of water, and I am in the habit of lifting it to pour out water for washing. Sometimes the servant has forgotten to fill it, and then I find that, when I take hold of the handle, the can goes up with a jerk. Long association has, in fact, led me to expect the can to have a considerable weight; and, [120] quite unawares, my muscular effort is adjusted to the expectation.

The process of strengthening generic memories of succession, and, at the same time, intensifying expectations of succession, is what is commonly called *verification.* The impression B has frequently been observed to follow the impression A. The association thus produced is represented as the memory, A-–> B. When the impression A appears again, the idea of B follows, associated with that of the immediate appearance of the impression B. If the impression B does appear, the expectation is said to be verified; while the memory A-–> B is strengthened, and gives rise in turn to a stronger expectation. And repeated verification may render that expectation so strong that its non-verification is inconceivable.

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[1] It is not worth while, for the present purpose, to consider whether, as all nervous action occupies a sensible time, the duration of one impression might not overlap that of the impression which follows it, in the case supposed.

[2] We give no name to faint memories; but expectations of like character play so large a part in human affairs, that they, together with the associated emotions of pleasure and pain, are distinguished as "hopes" or "fears."

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[121] Chapter V

The Mental Phenomena of Animals

In the course of the preceding chapters, attention has been more than once called to the fact, that the elements of consciousness and the operations of the mental faculties, under discussion, exist independently of and antecedent to, the existence of language.

If any weight is to be attached to arguments from analogy, there is overwhelming evidence in favour of the belief that children, before they can speak, and deaf mutes, possess the feelings to which those who have acquired the faculty of speech apply the name of sensations; that they have the feelings of relation; that trains of ideas pass through their minds; that generic ideas are formed from specific ones; and, that among these, ideas of memory and expectation occupy a most important place, inasmuch as, in their quality of potential beliefs, they furnish the grounds of action. This conclusion, in truth, is one of those which, though they cannot be demonstrated, are never [122] doubted; and, since it is highly probable and cannot be disproved, we are quite safe in accepting it, as, at any rate, a good working hypothesis.

But, if we accept it, we must extend it to a much wider assemblage of living beings. Whatever cogency

is attached to the arguments in favour of the occurrence of all the fundamental phenomena of mind in young children and deaf mutes, an equal force must be allowed to appertain to those which may be adduced to prove that the higher animals have minds. We must admit that Hume does not express himself too strongly when he says–

"no truth appears to me more evident, than that the beasts are endowed with thought and reason as well as man. The arguments are in this case so obvious, that they never escape the most stupid and ignorant."–(I. p. 232.)

In fact, this is one of the few cases in which the conviction which forces itself upon the stupid and the ignorant, is fortified by the reasonings of the intelligent, and has its foundation deepened by every increase of knowledge. It is not merely that the observation of the actions of animals almost irresistibly suggests the attribution to them of mental states, such as those which accompany corresponding actions in men. The minute comparison which has been instituted by anatomists and physiologists between the organs which we know to constitute the apparatus of thought in man, and the corresponding organs in brutes, has [123] demonstrated the existence of the closest similarity between the two, not only in structure, as far as the microscope will carry us, but in function, as far as functions are determinable by experiment. There is no question in the mind of any one acquainted with the facts that, so far as observation and experiment can take us, the structure and the functions of the nervous system are fundamentally the same in an ape, or in a dog, and in a man. And the suggestion that we must stop at the exact point at which direct proof fails us; and refuse to believe that the similarity which extends so far stretches yet further, is no better than a quibble. Robinson Crusoe did not feel bound to conclude, from the single human footprint which he saw in the sand, that the maker of the impression had only one leg.

Structure for structure, down to the minutest microscopical details, the eye, the ear, the olfactory organs, the nerves, the spinal cord, the brain of an ape, or of a dog, correspond with the same organs in the human subject. Cut a nerve, and the evidence of paralysis, or of insensibility, is the same in the two cases; apply pressure to the brain, or administer a narcotic, and the signs of intelligence disappear in the one as in the other. Whatever reason we have for believing that the changes which take place in the normal cerebral substance of man give rise to states of consciousness, the same reason exists for the belief that [124] the modes of motion of the cerebral substance of an ape, or of a dog, produce like effects.

A dog acts as if he had all the different kinds of impressions of sensation of which each of us is cognisant. Moreover, he governs his movements exactly as if he had the feelings of distance, form, succession, likeness, and unlikeness, with which we are familiar, or as if the impressions of relation were generated in his mind as they are in our own. Sleeping dogs frequently appear to dream. If they do, it must be admitted that ideation goes on in them while they are asleep; and, in that case, there is no reason to doubt that they are conscious of trains of ideas in their waking state. Further, that dogs, if they possess ideas at all, have memories and expectations, and those potential beliefs of which these states are the foundation, can hardly be doubted by any one who is conversant with their ways. Finally, there would appear to be no valid argument against the supposition that dogs form generic ideas of sensible objects. One of the most curious peculiarities of the dog mind is its inherent snobbishness, shown by the regard paid to external respectability. The dog who barks furiously at a beggar will let a well-dressed

man pass him without opposition. Has he not then a "generic idea" of rags and dirt associated with the idea of aversion, and that of sleek broadcloth associated with the idea of liking?

[125] In short, it seems hard to assign any good reason for denying to the higher animals any mental state, or process, in which the employment of the vocal or visual symbols of which language is composed is not involved; and comparative psychology confirms the position in relation to the rest of the animal world assigned to man by comparative anatomy. As comparative anatomy is easily able to show that, physically, man is but the last term of a long series of forms, which lead, by slow gradations, from the highest mammal to the almost formless speck of living protoplasm, which lies on the shadowy boundary between animal and vegetable life; so, comparative psychology, though but a young science, and far short of her elder sister's growth, points to the same conclusion.

In the absence of a distinct nervous system, we have no right to look for its product, consciousness: and, even in those forms of animal life in which the nervous apparatus has reached no higher degree of development, than that exhibited by the system of the spinal cord and the foundation of the brain in ourselves, the argument from analogy leaves the assumption of the existence of any form of consciousness unsupported. With the super-addition of a nervous apparatus corresponding with the cerebrum in ourselves, it is allowable to suppose the appearance of the simplest states of consciousness, or the sensations; [126] and it is conceivable that these may at first exist, without any power of reproducing them, as memories; and, consequently, without ideation. Still higher, an apparatus of correlation may be superadded, until, as all these organs become more developed, the condition of the highest speechless animals is attained.

It is a remarkable example of Hume's sagacity that he perceived the importance of a branch of science which, even now, can hardly be said to exist; and that, in a remarkable passage, he sketches in bold outlines the chief features of comparative psychology.

". . . any theory, by which we explain the operations of the understanding, or the origin and connection of the passions in man, will acquire additional authority if we find that the same theory is requisite to explain the same phenomena in all other animals. We shall make trial of this with regard to the hypothesis by which we have, in the foregoing discourse, endeavoured to account for all experimental reasonings; and it is hoped that this new point of view will serve to confirm all our former observations.

"First, it seems evident that animals, as well as men, learn many things from experience, and infer that the same events will always follow from the same causes. By this principle they become acquainted with the more obvious properties of external objects, and gradually, from their birth, treasure up a knowledge of the nature of fire, water, earth, stones, heights, depths, &c., and of the effects which result from their operation. The ignorance and inexperience of the young are here plainly distinguishable from the cunning and sagacity of the old, who have learned, by long observation, to avoid what hurt them, and pursue what gave ease or pleasure. A horse that has been accustomed to the field, becomes acquainted with the proper [127] height which he can leap, and will never attempt what exceeds his force and ability. An old greyhound will trust the more fatiguing part of the chase to the younger, and will place himself so as to meet the hare in her doubles; nor are the conjectures which he forms on this occasion founded on anything but his observation and experience

"This is still more evident from the effects of discipline and education on animals, who, by the proper application of rewards and punishments, may be taught any course of action, the most contrary to their natural instincts and propensities. Is it not experience which renders a dog apprehensive of pain when you menace him, or lift up the whip to beat him? Is it not even experience which makes him answer to his name, and infer from such an arbitrary sound that you mean him rather than any of his fellows, and intend to call him, when you pronounce it in a certain manner and with a certain tone and accent?

"In all these cases we may observe that the animal infers some fact beyond what immediately strikes his senses; and that this inference is altogether founded on past experience, while the creature expects from the present object the same consequences which it has always found in its observation to result from similar objects.

"*Secondly*, it is impossible that this inference of the animal can be founded on any process of argument or reasoning by which he concludes that like events must follow like objects, and that the course of nature will always be regular in its operations. For if there be in reality any arguments of this nature they surely lie too abstruse for the observation of such imperfect understandings; since it may well employ the utmost care and attention of a philosophic genius to discover and observe them. Animals therefore are not guided in these inferences by reasoning; neither are children; neither are the generality of mankind in their ordinary actions and conclusions; neither are philosophers themselves, who, in all the active parts of life, are in the main the same as the vulgar, and are governed by the same maxims. Nature must have provided some other principle, of more ready and more general use and application; nor can an operation of such immense consequence in life as that of in[128]ferring effects from causes, be trusted to the uncertain process of reasoning and argumentation. Were this doubtful with regard to men, it seems to admit of no question with regard to the brute creation; and the conclusion being once firmly established in the one, we have a strong presumption, from all the rules of analogy, that it ought to be universally admitted, without any exception or reserve. It is custom alone which engages animals, from every object that strikes their senses, to infer its usual attendant, and carries their imagination from the appearance of the one to conceive the other, in that particular manner which we denominate *belief*. No other explication can be given of this operation in all the higher as well as lower classes of sensitive beings which fall under our notice and observation."–(IV. pp. 122–4.)

It will be observed that Hume appears to contrast the "inference of the animal" with the "process of argument or reasoning in man." But it would be a complete misapprehension of his intention, if we were to suppose, that he thereby means to imply that there is any real difference between the two processes. The "inference of the animal" is a potential belief of expectation; the process of argument, or reasoning in man is based upon potential beliefs of expectation, which are formed in the man exactly in the same way as in the animal. But, in men endowed with speech the mental state which constitutes the potential belief is represented by a verbal proposition, and thus becomes what all the world recognises as a belief. The fallacy which Hume combats is, that the proposition, or verbal representative of a belief, has come to be regarded as a reality, [129] instead of as the mere symbol which it really is; and that reasoning, or logic, which deals with nothing but propositions, is supposed to be necessary in order to validate the natural fact symbolised by those propositions. It is a fallacy similar to that of supposing that money is the foundation of wealth, whereas it is only the wholly unessential symbol of property.

In the passage which immediately follows that just quoted, Hume makes admissions which might be turned to serious account against some of his own doctrines.

"But though animals learn many parts of their knowledge from observation, there are also many parts of it which they derive from the original hand of Nature, which much exceed the share of capacity they possess on ordinary occasions, and in which they improve, little or nothing, by the longest practice and experience. These we denominate Instincts, and are so apt to admire as something very extraordinary and inexplicable by all the disquisitions of human understanding. But our wonder will perhaps cease or diminish when we consider that the experimental reasoning itself, which we possess in common with beasts, and on which the whole conduct of life depends, is nothing but a species of instinct or mechanical power, that acts in us unknown to ourselves, and in its chief operations is not directed by any such relations or comparison of ideas as are the proper objects of our intellectual faculties.

"Though the instinct be different, yet still it is an instinct which teaches a man to avoid the fire, as much as that which teaches a bird, with such exactness, the art of incubation and the whole economy and order of its nursery."–(IV. pp. 125, 126.)

The parallel here drawn between the "avoidance of a fire" by a man and the incubatory [130] instinct of a bird is inexact. The man avoids fire when he has had experience of the pain produced by burning; but the bird incubates the first time it lays eggs, and therefore before it has had any experience of incubation. For the comparison to be admissible, it would be necessary that a man should avoid fire the first time he saw it, which is notoriously not the case.

The term "instinct" is very vague and ill-defined. It is commonly employed to denote any action, or even feeling, which is not dictated by conscious reasoning, whether it is, or is not, the result of previous experience. It is "instinct" which leads a chicken just hatched to pick up a grain of corn; parental love is said to be "instinctive"; the drowning man who catches at a straw does it "instinctively"; and the hand that accidentally touches something hot is drawn back by "instinct." Thus "instinct" is made to cover everything from a simple reflex movement, in which the organ of consciousness need not be at all implicated, up to a complex combination of acts directed towards a definite end and accompanied by intense consciousness.

But this loose employment of the term "instinct" really accords with the nature of the thing; for it is wholly impossible to draw any line of demarcation between reflex actions and instincts. If a frog, on the flank of which a little drop of acid has been placed, rubs it off with the [131] foot of the same side; and, if that foot be held, performs the same operation, at the cost of much effort, with the other foot, it certainly displays a curious instinct. But it is no less true that the whole operation is a reflex operation of the spinal cord, which can be performed quite as well when the brain is destroyed; and between which and simple reflex actions there is a complete series of gradations. In like manner, when an infant takes the breast, it is impossible to say whether the action should be rather termed instinctive or reflex.

What are usually called the instincts of animals are, however, acts of such a nature that, if they were performed by men, they would involve the generation of a series of ideas and of inferences from them; and it is a curious, apparently an insoluble, problem whether they are, or are not, accompanied by cerebral changes of the same nature as those which give rise to ideas and inferences in ourselves. When a chicken picks up a grain, for example, are there, firstly, certain sensations, accompanied by the feeling

of relation between the grain and its own body; secondly, a desire of the grain; thirdly, a volition to seize it? Or, are only the sensational terms of the series actually represented in consciousness?

The latter seems the more probable opinion, though it must be admitted that the other alternative is possible. But, in this case, the series of [132] mental states which occurs is such as would be represented in language by a series of propositions, and would afford proof positive of the existence of innate ideas, in the Cartesian sense. Indeed, a metaphysical fowl, brooding over the mental operations of his fully-fledged consciousness, might appeal to the fact as proof that, in the very first action of his life, he assumed the existence of the Ego and the non-Ego, and of a relation between the two.

In all seriousness, if the existence of instincts be granted, the possibility of the existence of innate ideas, in the most extended sense ever imagined by Descartes, must also be admitted. In fact, Descartes, as we have seen, illustrates what he means by an innate idea, by the analogy of hereditary diseases or hereditary mental peculiarities, such as generosity. On the other hand, hereditary mental tendencies may justly be termed instincts; and still more appropriately might those special proclivities, which constitute what we call genius, come into the same category.

The child who is impelled to draw as soon as it can hold a pencil; the Mozart who breaks out into music as early; the boy Bidder who worked out the most complicated sums without learning arithmetic; the boy Pascal who evolved Euclid out of his own consciousness: all these may be said to have been impelled by instinct, as much as are the beaver and the bee. And the man of [133] genius is distinct in kind from the man of cleverness, by reason of the working within him of strong innate tendencies–which cultivation may improve, but which it can no more create, than horticulture can make thistles bear figs. The analogy between a musical instrument and the mind holds good here also. Art and industry may get much music, of a sort, out of a penny whistle; but, when all is done, it has no chance against an organ. The innate musical potentialities of the two are infinitely different.

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[134] Chapter VI

Language–Propositions Concerning Necessary Truths

Though we may accept Hume's conclusion that speechless animals think, believe, and reason; yet, it must be borne in mind, that there is an important difference between the signification of the terms when applied to them and when applied to those animals which possess language. The thoughts of the former are trains of mere feelings; those of the latter are, in addition, trains of the ideas of the signs which represent feelings, and which are called "words."

A word, in fact, is a spoken or written sign, the idea of which is, by repetition, so closely associated with the idea of the simple or complex feeling which it represents, that the association becomes indissoluble. No Englishman, for example, can think of the word "dog" without immediately having the idea of the group of impressions to which that name is given; and conversely, the [135] group of impressions

immediately calls up the idea of the word "dog."

The association of words with impressions and ideas is the process of naming; and language approaches perfection, in proportion as the shades of difference between various ideas and impressions are represented by differences in their names.

The names of simple impressions and ideas, or of groups of co-existent or successive complex impressions and ideas, considered *per se*, are substantives; as redness, dog, silver, mouth; while the names of impressions or ideas considered as parts or attributes of a complex whole, are adjectives. Thus redness, considered as part of the complex idea of a rose, becomes the adjective red; flesh-eater, as part of the idea of a dog, is represented by carnivorous; whiteness, as part of the idea of silver, is white; and so on.

The linguistic machinery for the expression of belief is called *predication;* and, as all beliefs express ideas of relation, we may say that the sign of predication is the verbal symbol of a feeling of relation. The words which serve to indicate predication are verbs. If I say "silver" and then "white," I merely utter two names; but if I interpose between them the verb "is," I express a belief in the co-existence of the feeling of whiteness with the other feelings which constitute the totality of the complex idea of silver; in other words, I predicate "whiteness" of silver.

[136] In such a case as this, the verb expresses predication and nothing else, and is called a copula. But, in the great majority of verbs, the word is the sign of a complex idea, and the predication is expressed only by its form. Thus in "silver shines," the verb "to shine" is the sign for the feeling of brightness, and the mark of predication lies in the form "shines."

Another result is brought about by the forms of verbs. By slight modifications they are made to indicate that a belief, or predication, is a memory, or is an expectation. Thus "silver *shone*" expresses a memory; "silver *will* shine" an expectation.

The form of words which expresses a predication is a proposition. Hence, every predication is the verbal equivalent of a belief; and, as every belief is either an immediate consciousness, a memory, or an expectation, and as every expectation is traceable to a memory, it follows that, in the long run, all propositions express either immediate states of consciousness, or memories. The proposition which predicates A of X must mean either, that the fact is testified by my present consciousness, as when I say that two colours, visible at this moment, resemble one another; or that A is indissolubly associated with X in memory; or that A is indissolubly associated with X in expectation. But it has already been shown that expectation is only an expression of memory.

[137] Hume does not discuss the nature of language, but so much of what remains to be said, concerning his philosophical tenets, turns upon the value and the origin of verbal propositions, that this summary sketch of the relations of language to the thinking process will probably not be deemed superfluous.

So large an extent of the field of thought is traversed by Hume, in his discussion of the verbal propositions in which mankind enshrine their beliefs, that it would be impossible to follow him throughout all the windings of his long journey, within the limits of this essay. I purpose, therefore, to limit myself to those propositions which concern–l. Necessary Truths; 2. The order of Nature; 3. The Soul; 4. Theism; 5. The Passions and Volition; 6. The Principle of Morals.

Hume's views respecting necessary truths, and more particularly concerning causation, have, more than any other part of his teaching, contributed to give him a prominent place in the history of philosophy.

"All the objects of human reason and inquiry may naturally be divided into two kinds, to wit, *relations of ideas* and *matters of fact.* Of the first kind are the sciences of geometry, algebra, and arithmetic, and, in short, every affirmation which is either intuitively or demonstratively certain. *That the square of the hypotenuse is equal to the square of the two sides,* is a proposition which expresses a relation between these two figures. *That three times five is equal to the half of thirty,* expresses a relation [138] between these numbers. Propositions of this kind are discoverable by the mere operation of thought without dependence on whatever is anywhere existent in the universe. Though there never were a circle or a triangle in nature, the truths demonstrated by Euclid would for ever retain their certainty and evidence.

"Matters of fact, which are the second objects of human reason, are not ascertained in the same manner, nor is an evidence of their truth, however great, of a like nature with the foregoing. The contrary of every matter of fact is still possible, because it can never imply a contradiction, and is conceived by the mind with the same facility and distinctness, as if ever so conformable to reality. *That the sun will not rise tomorrow,* is no less intelligible a proposition, and implies no more contradiction, than the affirmation, that it *will* rise. We should in vain, therefore, attempt to demonstrate its falsehood. Were it demonstratively false, it would imply a contradiction, and could never be distinctly conceived by the mind."–(IV. pp. 32, 33.)

The distinction here drawn between the truths of geometry and other kinds of truth is far less sharply indicated in the "Treatise," but as Hume expressly disowns any opinions on these matters but such as are expressed in the "Inquiry," we may confine ourselves to the latter; and it is needful to look narrowly into the propositions here laid down, as much stress has been laid upon Hume's admission that the truths of mathematics are intuitively and demonstratively certain; in other words, that they are necessary and, in that respect, differ from all other kinds of belief.

What is meant by the assertion that "propositions of this kind are discoverable by the [139] mere operation of thought without dependence on what is anywhere existent in the universe"?

Suppose that there were no such things as impressions of sight and touch anywhere in the universe, what idea could we have even of a straight line, much less of a triangle and of the relations between its sides? The fundamental proposition of all Hume's philosophy is that ideas are copied from impressions; and, therefore, if there were no impressions of straight lines and triangles there could be no ideas of straight lines and triangles. But what we mean by the universe is the sum of our actual and possible impressions.

So, again, whether our conception of number is derived from relations of impressions in space or in

time, the impressions must exist in nature, that is, in experience, before their relations can be perceived. Form and number are mere names for certain relations between matters of fact; unless a man had seen or felt the difference between a straight line and a crooked one, straight and crooked would have no more meaning to him, than red and blue to the blind.

The axiom, that things which are equal to the same are equal to one another, is only a particular case of the predication of similarity; if there were no impressions, it is obvious that there could be no predicates. But what is an existence in the universe but an impression?

[140] If what are called necessary truths are rigidly analysed, they will be found to be of two kinds, Either they depend on the convention which underlies the possibility of intelligible speech, that terms shall always have the same meaning; or they are propositions the negation of which implies the dissolution of some association in memory or expectation, which is in fact indissoluble; or the denial of some fact of immediate consciousness.

The "necessary truth" A = A means that the perception which is called A shall always be called A. The "necessary truth" that "two straight lines cannot inclose a space," means that we have no memory, and can form no expectation of their so doing. The denial of the "necessary truth" that the thought now in my mind exists, involves the denial of consciousness.

To the assertion that the evidence of matter of fact is not so strong as that of relations of ideas, it may be justly replied, that a great number of matters of fact are nothing but relations of ideas. If I say that red is unlike blue, I make an assertion concerning a relation of ideas; but it is also matter of fact, and the contrary proposition is inconceivable. If I remember[1] something that happened five minutes ago, that is matter of fact; and, at the same time, it expresses a relation [141] between the event remembered and the present time. It is wholly inconceivable to me that the event did not happen, so that my assurance respecting it is as strong as that which I have respecting any other necessary truth. In fact, the man is either very wise, or very virtuous, or very lucky, perhaps all three, who has gone through life without accumulating a store of such necessary beliefs which he would give a good deal to be able to disbelieve.

It would be beside the mark to discuss the matter further on the present occasion. It is sufficient to point out that, whatever may be the differences between mathematical and other truths, they do not justify Hume's statement. And it is, at any rate, impossible to prove that the cogency of mathematical first principles is due to anything more than these circumstances; that the experiences with which they are concerned are among the first which arise in the mind; that they are so incessantly repeated as to justify us, according to the ordinary laws of ideation, in expecting that the associations which they form will be of extreme tenacity; while the fact, that the expectations based upon them are always verified, finishes the process of welding them together.

Thus, if the axioms of mathematics are innate, nature would seem to have taken unnecessary trouble; since the ordinary process of association [142] appears to be amply sufficient to confer upon them all the universality and necessity which they actually possess.

Whatever needless admissions Hume may have made respecting other necessary truths he is quite clear about the axiom of causation, "That whatever event has a beginning must have a cause;" whether and in what sense it is a necessary truth; and, that question being decided, whence it is derived.

With respect to the first question, Hume denies that it is a necessary truth, in the sense that we are unable to conceive the contrary. The evidence by which he supports this conclusion in the "Inquiry," however, is not strictly relevant to the issue.

"No object ever discovers, by the qualities which appear to the senses, either the cause which produced it, or the effects which will arise from it; nor can our reason, unassisted by experience, ever draw any inference concerning real existence and matter of fact."–(IV. P. 35.)

Abundant illustrations are given of this assertion, which indeed cannot be seriously doubted; but it does not follow that, because we are totally unable to say what cause preceded, or what effect will succeed, any event, we do not necessarily suppose that the event had a cause and will be succeeded by an effect. The scientific investigator who notes a new phenomenon may be utterly [143] ignorant of its cause, but he will, without hesitation, seek for that cause. If you ask him why he does so, he will probably say that it must have had a cause; and thereby imply that his belief in causation is a necessary belief.

In the "Treatise" Hume indeed takes the bull by the horns:

". . . as all distinct ideas are separable from each other; and as the ideas of cause and effect are evidently distinct, 'twill be easy for us to conceive any object to be non-existent this moment and existent the next, without conjoining to it the distinct idea of a cause or productive principle."–(I. p. 111.)

If Hume had been content to state what he believed to be matter of fact, and had abstained from giving superfluous reasons for that which is susceptible of being proved or disproved only by personal experience, his position would have been stronger. For it seems clear that, on the ground of observation, he is quite right. Any man who lets his fancy run riot in a waking dream, may experience the existence at one moment, and the non-existence at the next, of phenomena which suggest no connexion of cause and effect. Not only so, but it is notorious that, to the unthinking mass of mankind, nine-tenths of the facts of life do not suggest the relation of cause and effect; and they practically deny the existence of any such relation by attributing them to chance. Few gamblers but would stare if they were told that the falling of a die on a particular face is as [144] much the effect of a definite cause as the fact of its falling; it is a proverb that "the wind bloweth where it listeth"; and even thoughtful men usually receive with surprise the suggestion, that the form of the crest of every wave that breaks, wind-driven, on the sea-shore, and the direction of every particle of foam that flies before the gale, are the exact effects of definite causes; and, as such, must be capable of being determined, deductively, from the laws of motion and the properties of air and water. So again, there are large numbers of highly intelligent persons who rather pride themselves on their fixed belief that our volitions have no cause; or that the will causes itself, which is either the same thing, or a contradiction in terms.

Hume's argument in support of what appears to be a true proposition, however, is of the circular sort, for the major premiss, that all distinct ideas are separable in thought, assumes the question at issue.

But the question whether the idea of causation is necessary, or not, is really of very little importance. For, to say that an idea is necessary is simply to affirm that we cannot conceive the contrary; and the fact that we cannot conceive the contrary of any belief may be a presumption, but is certainly no proof, of its truth.

In the well-known experiment of touching a single round object, such as a marble, with crossed [145] fingers, it is utterly impossible to conceive that we have not two round objects under them; and, though light is undoubtedly a mere sensation arising in the brain, it is utterly impossible to conceive that it is not outside the retina. In the same way, he who touches anything with a rod, not only is irresistibly led to believe that the sensation of contact is at the end of the rod, but is utterly incapable of conceiving that this sensation is really in his head. Yet that which is inconceivable is manifestly true in all these cases. The beliefs and the unbeliefs are alike necessary, and alike erroneous.

It is commonly urged that the axiom of causation cannot be derived from experience, because experience only proves that many things have causes, whereas the axiom declares that all things have causes. The syllogism, "many things which come into existence have causes. A has come into existence: therefore A had a cause," is obviously fallacious, if A is not previously shown to be one of the "many things." And this objection is perfectly sound so far as it goes. The axiom of causation cannot possibly be deduced from any general proposition which simply embodies experience. But it does not follow that the belief, or expectation, expressed by the axiom, is not a product of experience, generated antecedently to, and altogether independently of, the logically unjustifiable language in which we express it.

[146] In fact, the axiom of causation resembles all other beliefs of expectation in being the verbal symbol of a purely automatic act of the mind, which is altogether extra-logical, and would be illogical, if it were not constantly verified by experience. Experience, as we have seen, stores up memories; memories generate expectations or beliefs–why they do so may be explained hereafter by proper investigation of cerebral physiology. But to seek for the reason of the facts in the verbal symbols by which they are expressed, and to be astonished that it is not to be found there, is surely singular; and what Hume did was to turn attention from the verbal proposition to the psychical fact of which it is the symbol.

"When any natural object or event is presented, it is impossible for us, by any sagacity or penetration, to discover, or even conjecture, without experience, what event will result from it, or to carry our foresight beyond that object, which is immediately present to the memory and senses. Even after one instance or experiment, where we have observed a particular event to follow upon another, we are not entitled to form a general rule, or foretell what will happen in like cases; it being justly esteemed an unpardonable temerity to judge of the whole course of nature from one single experiment, however accurate or certain. But when one particular species of events has always, in all instances, been conjoined with another, we make no longer any scruple of foretelling one upon the appearance of the other, and of employing that reasoning which can alone assure us of any matter of fact or existence. We then call the one object *Cause*, the other *Effect*. We suppose that there is some connexion between

them: some power in the one, by which it infallibly produces the other, and operates with the [147] greatest certainty and strongest necessity.... But there is nothing in a number of instances, different from every single instance, which is supposed to be exactly similar; except only, that after a repetition of similar instances, the mind is carried by habit, upon the appearance of one event, to expect its usual attendant, and to believe that it will exist.... The first time a man saw the communication of motion by impulse, as by the shock of two billiard balls, he could not pronounce that the one event was *connected,* but only that it was *conjoined,* with the other. After he has observed several instances of this nature, he then pronounces them to be *connected.* What alteration has happened to give rise to this new idea of *connexion*? Nothing but that he now *feels* these events to be *connected* in his imagination, and can readily foresee the existence of the one from the appearance of the other. When we say, therefore, that one object is connected with another we mean only that they have acquired a connexion in our thought, and give rise to this inference, by which they become proofs of each other's existence; a conclusion which is somewhat extraordinary, but which seems founded on sufficient evidence."–(IV. pp. 87–89.)

In the fifteenth section of the third part of the "Treatise," under the head of the *Rules by which to Judge of Causes and Effects,* Hume gives a sketch of the method of allocating effects to their causes, upon which, so far as I am aware, no improvement was made down to the time of the publication of Mill's "Logic." Of Mill's four methods, that of *agreement* is indicated in the following passage-–

". . . where several different objects produce the same effect, it must be by means of some quality which we discover to be common amongst them. For as like effects imply like causes, we must always ascribe the causation to the circumstance wherein we discover the resemblance."–(1. p. 229.)

[148] Next, the foundation of the *method of difference* is stated:–

"The difference in the effects of two resembling objects must proceed from that particular in which they differ. For, as like causes always produce like effects, when in any instance we find our expectation to be disappointed, we must conclude that this irregularity proceeds from some difference in the causes."–(I. p. 230)

In the succeeding paragraph the *method of concomitant variations* is foreshadowed.

"When any object increases or diminishes with the increase or diminution of the cause, 'tis to be regarded as a compounded effect, derived from the union of the several different effects which arise from the several different parts of the cause. The absence or presence of one part of the cause is here supposed to be always attended with the absence or presence of a proportionable part of the effect. This constant conjunction sufficiently proves that the one part is the cause of the other. We must, however, beware not to draw such a conclusion from a few experiments."–(I. p. 230.)

Lastly, the following rule, though awkwardly stated, contains a suggestion of the *method of residues* :–

"... an object which exists for any time in its full perfection without any effect, is not the sole cause of that effect, but requires to be assisted by some other principle, which may forward its influence and operation. For as like effects necessarily follow from like causes, and in a contiguous time and place, their separation for a moment shows that these causes are not complete ones."–(1. p. 230.)

In addition to the bare notion of necessary connexion between the cause and its effect, we un[149] doubtedly find in our minds the idea of something resident in the cause which, as we say, produces the effect, and we call this something Force, Power, or Energy. Hume explains Force and Power as the results of the association with inanimate causes of the feelings of endeavour or resistance which we experience, when our bodies give rise to, or resist, motion.

If I throw a ball, I have a sense of effort which ends when the ball leaves my hand; and, if I catch a ball, I have a sense of resistance which comes to an end with the quiescence of the ball. In the former case, there is a strong suggestion of something having gone from myself into the ball; in the latter, of something having been received from the ball. Let any one hold a piece of iron near a strong magnet, and the feeling that the magnet endeavours to pull the iron one way, in the same manner as he endeavours to pull it in the opposite direction, is very strong.

As Hume says:–

"No animal can put external bodies in motion without the sentiment of a *nisus*, or endeavour; and every animal has a sentiment or feeling from the stroke or blow of an external object that is in motion. These sensations, which are merely animal, and from which we can, *a priori*, draw no inference, we are apt to transfer to inanimate objects, and to suppose that they have some such feelings whenever they transfer or receive motion."–(IV. p. 91, *note*.)

It is obviously, however, an absurdity not less [150] gross than that of supposing the sensation of warmth to exist in a fire, to imagine that the subjective sensation of effort, or resistance, in ourselves can be present in external objects, when they stand in the relation of causes to other objects.

To the argument, that we have a right to suppose the relation of cause and effect to contain something more than invariable succession, because, when we ourselves act as causes, or in volition, we are conscious of exerting power; Hume replies, that we know nothing of the feeling we call power except as effort or resistance; and that we have not the slightest means of knowing whether it has anything to do with the production of bodily motion or mental changes. And he points out, as Descartes and Spinoza had done before him, that when voluntary motion takes place, that which we will is not the immediate consequence of the act of volition, but something which is separated from it by a long chain of causes and effects. If the will is the cause of the movement of a limb, it can be so only in the sense that the guard who gives the order to go on, is the cause of the transport of a train from one station to another.

"We learn from anatomy, that the immediate object of power in voluntary notion is not the member itself which is moved but certain muscles and nerves and animal spirits, and perhaps something still more minute and unknown, through which the motion is successively propagated, ere it reached the member [151] itself, whose motion is the immediate object of volition. Can there be a more certain proof that the power by which the whole operation is performed, so far from being directly and fully known by an inward sentiment or consciousness, is to the last degree mysterious and unintelligible? Here the mind wills a certain event: Immediately another event, unknown to ourselves, and totally different from the one intended, is produced: This event produces another equally unknown: Till at last, through a long succession, the desired event is produced."–(IV. p. 78.)

A still stronger argument against ascribing an objective existence to force or power, on the strength of our supposed direct intuition of power in voluntary acts, may be urged from the unquestionable fact, that we do not know, and cannot know, that volition does cause corporeal motion; while there is a great deal to be said in favour of the view that it is no cause, but merely a concomitant of that motion. But the nature of volition will be more fitly considered hereafter.

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[1] Hume, however, expressly includes the "records of our memory" among his matters of fact.–(IV. p. 33.)

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[152] Chapter VII

The Order of Nature: Miracles

If our beliefs of expectation are based on our beliefs of memory, and anticipation is only inverted recollection, it necessarily follows that every belief of expectation implies the belief that the future will have a certain resemblance to the past. From the first hour of experience, onwards, this belief is constantly being verified, until old age is inclined to suspect that experience has nothing new to offer. And when the experience of generation after generation is recorded, and a single book tells us more than Methuselah could have learned, had he spent every waking hour of his thousand years in learning; when apparent disorders are found to be only the recurrent pulses of a slow working order, and the wonder of a year becomes the commonplace of a century; when repeated and minute examination never reveals a break in the chain of causes and effects; and the [153] whole edifice of practical life is built upon our faith in its continuity; the belief, that that chain has never been broken and will never be broken, becomes one of the strongest and most justifiable of human convictions. And it must be admitted to be a reasonable request, if we ask those who would have us put faith in the actual occurrence of interruptions of that order, to produce evidence in favour of their view, not only equal, but superior, in weight to that which leads us to adopt ours.

This is the essential argument of Hume's famous disquisition upon miracles; and it may safely be declared to be irrefragable. But it must be admitted that Hume has surrounded the kernel of his essay with a shell of very doubtful value.

The first step in this, as in all other discussions, is to come to a clear understanding as to the meaning of the terms employed. Argumentation whether miracles are possible, and, if possible, credible, is mere beating the air until the arguers have agreed what they mean by the word "miracles."

Hume, with less than his usual perspicuity, but in accordance with a common practice of believers in the miraculous, defines a miracle as a "violation of the laws of nature," or as "a transgression of a law of nature by a particular volition of the Deity, or by the interposition of some invisible agent."

There must, he says,–

[154] "be an uniform experience against every miraculous event, otherwise the event would not merit that appellation. And as an uniform experience amounts to a proof, there is here a direct and full proof, from the nature of the fact, against the existence of any miracle; nor can such a proof be destroyed or the miracle rendered credible but by an opposite proof which is superior."–(IV. p. 134.)

Every one of these dicta appears to be open to serious objection.

The word "miracle"–*miraculum*,–in its primitive and legitimate sense, simply means something wonderful.

Cicero applies it as readily to the fancies of philosophers, "Portenta et miracula philosophorum somniantium," as we do to the prodigies of priests. And the source of the wonder which a miracle excites is the belief, on the part of those who witness it, that it transcends, or contradicts, ordinary experience.

The definition of a miracle as a "violation of the laws of nature" is, in reality, an employment of language which, on the face of the matter, cannot be justified. For "nature" means neither more nor less than that which is; the sum of phenomena presented to our experience; the totality of events past, present, and to come. Every event must be taken to be a part of nature until proof to the contrary is supplied. And such proof is, from the nature of the case, impossible.

Hume asks:–

[155] "Why is it more than probable that all men must die: that lead cannot of itself remain suspended in the air: that fire consumes wood and is extinguished by water; unless it be that these events are found agreeable to the laws of nature, and there is required a violation of those laws, or in other words a miracle, to prevent them?"–(IV. p. 133.)

But the reply is obvious; not one of these events is "more than probable"; though the probability may reach such a very high degree that, in ordinary language, we are justified in saying that the opposite events are impossible. Calling our often verified experience a "law of nature" adds nothing to its value, nor in the slightest degree increases any probability that it will be verified again, which may arise out of the fact of its frequent verification.

If a piece of lead were to remain suspended of itself, in the air, the occurrence would be a "miracle," in the sense of a wonderful event, indeed; but no one trained in the methods of science would imagine that any law of nature was really violated thereby. He would simply set to work to investigate the conditions under which so highly unexpected an occurrence took place; and thereby enlarge his experience and modify his, hitherto, unduly narrow conception of the laws of nature.

The alternative definition, that a miracle is "a transgression of a law of nature by a particular volition of the Deity, or by the interposition of [156] some invisible agent," (IV. p. 134, *note*) is still less defensible. For a vast number of miracles have professedly been worked, neither by the Deity, nor by any invisible agent; but by Beelzebub and his compeers, or by very visible men.

Moreover, not to repeat what has been said respecting the absurdity of supposing that something which occurs is a transgression of laws, our only knowledge of which is derived from the observation of that which occurs; upon what sort of evidence can we be justified in concluding that a given event is the effect of a particular volition of the Deity, or of the interposition of some invisible (that is unperceivable) agent? It may be so, but how is the assertion, that it is so, to be tested? If it be said that the event exceeds the power of natural causes, what can justify such a saying? The day-fly has better grounds for calling a thunderstorm supernatural, than has man, with his experience of an infinitesimal fraction of duration, to say that the most astonishing event that can be imagined is beyond the scope of natural causes.

"Whatever is intelligible and can be distinctly conceived, implies no contradiction, and can never be proved false by any demonstration, argument, or abstract reasoning *a priori.* "–(IV. p. 44.)

So wrote Hume, with perfect justice, in his "Sceptical Doubts." But a miracle, in the sense of a sudden and complete change in the customary [157] order of nature, is intelligible, can be distinctly conceived, implies no contradiction; and therefore, according to Hume's own showing, cannot be proved false by any demonstrative argument.

Nevertheless, in diametrical contradiction to his own principles, Hume says elsewhere:–

"It is a miracle that a dead man should come to life: because that has never been observed in any age or country."–(IV. p. 134.)

That is to say, there is an uniform experience against such an event, and therefore, if it occurs, it is a violation of the laws of nature. Or, to put the argument in its naked absurdity, that which never has happened never can happen, without a violation of the laws of nature. In truth, if a dead man did come to life, the fact would be evidence, not that any law of nature had been violated, but that those laws, even when they express the results of a very long and uniform experience, are necessarily based on incomplete knowledge, and are to be held only as grounds of more or less justifiable expectation.

To sum up, the definition of a miracle as a suspension or a contravention of the order of Nature is self-contradictory, because all we know of the order of nature is derived from our observation of the course of events of which the so-called miracle is a part. On the other hand, no conceivable event, however extraordinary, is impossible; and therefore, if by the term miracles [158] we mean only "extremely wonderful events," there can be no just ground for denying the possibility of their occurrence.

But when we turn from the question of the possibility of miracles, however they may be defined, in the

abstract, to that respecting the grounds upon which we are justified in believing any particular miracle, Hume's arguments have a very different value, for they resolve themselves into a simple statement of the dictates of common sense–which may be expressed in this canon: the more a statement of fact conflicts with previous experience, the more complete must be the evidence which is to justify us in believing it. It is upon this principle that every one carries on the business of common life. If a man tells me he saw a piebald horse in Piccadilly, I believe him without hesitation. The thing itself is likely enough, and there is no imaginable motive for his deceiving me. But if the same person tells me he observed a zebra there, I might hesitate a little about accepting his testimony, unless I were well satisfied, not only as to his previous acquaintance with zebras, but as to his powers and opportunities of observation in the present case. If, however, my informant assured me that he beheld a centaur trotting down that famous thoroughfare, I should emphatically decline to credit his statement; and this even if he were the most saintly of men and [159] ready to suffer martyrdom in support of his belief. In such a case, I could, of course, entertain no doubt of the good faith of the witness; it would be only his competency, which unfortunately has very little to do with good faith, or intensity of conviction, which I should presume to call in question.

Indeed, I hardly know what testimony would satisfy me of the existence of a live centaur. To put an extreme case, suppose the late Johannes Müller, of Berlin, the greatest anatomist and physiologist among my contemporaries, had barely affirmed that he had seen a live centaur, I should certainly have been staggered by the weight of an assertion coming from such an authority. But I could have got no further than a suspension of judgment. For, on the whole, it would have been more probable that even he had fallen into some error of interpretation of the facts which came under his observation, than that such an animal as a centaur really existed. And nothing short of a careful monograph, by a highly competent investigator, accompanied by figures and measurements of all the most important parts of a centaur, put forth under circumstances which could leave no doubt that falsification or misinterpretation would meet with immediate exposure, could possibly enable a man of science to feel that he acted conscientiously, in expressing his belief in the existence of a centaur on the evidence of testimony.

[160] This hesitation about admitting the existence of such an animal as a centaur, be it observed, does not deserve reproach, as scepticism, but moderate praise, as mere scientific good faith. It need not imply, and it does not, so far as I am concerned, any *a priori* hypothesis that a centaur is an impossible animal; or, that his existence, if he did exist, would violate the laws of nature. Indubitably, the organisation of a centaur presents a variety of practical difficulties to an anatomist and physiologist; and a good many of those generalisations of our present experience, which we are pleased to call laws of nature, would be upset by the appearance of such an animal, so that we should have to frame new laws to cover our extended experience. Every wise man will admit that the possibilities of nature are infinite, and include centaurs; but he will not the less feel it his duty to hold fast, for the present, by the dictum of Lucretius, "Nam certe ex vivo Centauri non fit imago," and to cast the entire burthen of proof, that centaurs exist, on the shoulders of those who ask him to believe the statement.

Judged by the canons either of common sense, or of science, which are indeed one and the same,[1] all "miracles" are centaurs, or they would not be miracles; and men of sense and science will deal [161]

with them on the same principles. No one who wishes to keep well within the limits of that which he has a right to assert will affirm that it is impossible that the sun and moon should ever have been made to appear to stand still in the valley of Ajalon; or that the walls of a city should have fallen down at a trumpet blast; or that water was turned into wine; because such events are contrary to uniform experience and violate laws of nature. For aught he can prove to the contrary, such events may appear in the order of nature to-morrow. But common sense and common honesty alike oblige him to demand from those who would have him believe in the actual occurrence of such events, evidence of a cogency proportionate to their departure from probability; evidence at least as strong as that, which the man who says he has seen a centaur is bound to produce, unless he is content to be thought either more than credulous or less than honest.

But are there any miracles on record, the evidence for which fulfils the plain and simple requirements alike of elementary logic and of elementary morality?

Hume answers this question without the smallest hesitation, and with all the authority of a historical specialist:–

"There is not to be found, in all history, any miracle attested by a sufficient number of men, of such unquestioned goodness, education, and learning, as to secure us against all delusion in [162] themselves; of such undoubted integrity, as to place them beyond all suspicion of any design to deceive others; of such credit and reputation in the eyes of mankind, as to have a great deal to lose in case of their being detected in any falsehood; and at the same time attesting facts, performed in such a public manner, and in so celebrated a part of the world, as to render the detection unavoidable: All which circumstances are requisite to give us a full assurance of the testimony of men."–(IV. p. 136.)

These are grave assertions; but they are least likely to be challenged by those who have made it their business to weigh evidence and to give their decision, under a due sense of the moral responsibility which they incur in so doing.

It is probable that few persons who proclaim their belief in miracles have considered what would be necessary to justify that belief in the case of a professed modern miracle-worker. Suppose, for example, it is affirmed that A. B. died and that C. D. brought him to life again. Let it be granted that A. B. and C. D. are persons of unimpeachable honour and veracity; that C. D. is the next heir to A. B.'s estate, and therefore had a strong motive for not bringing him to life again; and that all A. B.'s relations, respectable persons who bore him a strong affection, or had otherwise an interest in his being alive, declared that they saw him die. Furthermore, let A. B. be seen after his recovery by all his friends and neighbours, and let his and their depositions, that he is now alive, be taken down before a magistrate of known [163] integrity and acuteness: would all this constitute even presumptive evidence that C. D. had worked a miracle? Unquestionably not. For the most important link in the whole chain of evidence is wanting, and that is the proof that A. B. was really dead. The evidence of ordinary observers on such a point as this is absolutely worthless. And, even medical evidence, unless the physician is a person of unusual knowledge and skill, may have little more value. Unless careful thermometric observation proves that the temperature has sunk below a certain point; unless the cadaveric stiffening of the muscles has

become well established; all the ordinary signs of death may be fallacious, and the intervention of C. D. may have had no more to do with A. B.'s restoration to life than any other fortuitously coincident event.

It may be said that such a coincidence would be more wonderful than the miracle itself. Nevertheless history acquaints us with coincidences as marvellous.

On the 19th of February, 1842, Sir Robert Sale held Jellalabad with a small English force and, daily expecting attack from an overwhelming force of Afghans, had spent three months in incessantly labouring to improve the fortifications of the town. Akbar Khan had approached within a few miles, and an onslaught of his army was supposed to be imminent. That morning an earthquake–

[164] "nearly destroyed the town, threw down the greater part of the parapets, the central gate with the adjoining bastions, and a part of the new bastion which flanked it. Three other bastions were also nearly destroyed, whilst several large breaches were made in the curtains, and the Peshawur side, eighty feet long, was quite practicable, the ditch being filled, and the descent easy. Thus, in one moment, the labours of three months were in a great measure destroyed."[2]

If Akbar Khan had happened to give orders for an assault in the early morning of the l9th of February, what good follower of the Prophet could have doubted that Allah had lent his aid? As it chanced, however, Mahometan faith in the miraculous took another turn; for the energetic defenders of the post had repaired the damage by the end of the month; and the enemy, finding no signs of the earthquake when they invested the place, ascribed the supposed immunity of Jellalabad to English witchcraft.

But the conditions of belief do not vary with time or place; and, if it is undeniable that evidence of so complete and weighty a character is needed, at the present time, for the establishment of the occurrence of such a wonder as that supposed, it has always been needful. Those who study the extant records of miracles with due attention will judge for themselves how far it has ever been supplied.

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[1] See above (p. 68) the pregnant aphorism, "philosophical decisions are nothing but the reflections of common life, methodised and corrected." [1893.]

[2] Report of Captain Broadfoot, garrison engineer, quoted in Kaye's *Afghanistan.*

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[165] Chapter VIII

Theism; Evolution of Theology

Hume seems to have had but two hearty dislikes: the one to the English nation, and the other to all the professors of dogmatic theology. The one aversion he vented only privately to his friends; but, if he is

ever bitter in his public utterances, it is against priests[1] in general and theological enthusiasts and fanatics in particular; if he ever seems insincere, it is when he wishes to insult theologians by a parade of sarcastic respect. One need go no further than the peroration of the "Essay on Miracles" for a characteristic illustration.

[166]"I am the better pleased with the method of reasoning here delivered, as I think it may serve to confound those dangerous friends and disguised enemies to the *Christian Religion* who have undertaken to defend it by the principles of human reason. Our most holy religion is founded on *Faith,* not on reason, and it is a sure method of exposing it to put it to such a trial as it is by no means fitted to endure.... the Christian religion not only was at first attended with miracles, but even at this day cannot be believed by any reasonable person without one. Mere reason is insufficient to convince us of its veracity: And whoever is moved by *Faith* to assent to it, is conscious of a continual miracle in his own person, which subverts all the principles of his understanding and gives him a determination to believe what is most contrary to custom and experience."–(IV. pp. 153, 154.)

It is obvious that, here and elsewhere, Hume, adopting a popular confusion of ideas, uses religion as the equivalent of dogmatic theology; and, therefore, he says, with perfect justice, that "religion is nothing but a species of philosophy" (iv. p 171). Here no doubt lies the root of his antagonism. The quarrels of theologians and philosophers have not been about religion, but about philosophy; and philosophers not unfrequently seem to entertain the same feeling towards theologians that sportsmen cherish towards poachers. "There cannot be two passions more nearly resembling each other than hunting and philosophy," says Hume. And philosophic hunters are given to think, that, while they pursue truth for its own sake, out of pure love for the chase (perhaps mingled with a little human weak[167]ness to be thought good shots), and by open and legitimate methods; their theological competitors too often care merely to supply the market of establishments; and disdain neither the aid of the snares of superstition, nor the cover of the darkness of ignorance.

Unless some foundation was given for this impression by the theological writers whose works had fallen in Hume's way, it is difficult to account for the depth of feeling which so good-natured a man manifests on the subject.

Thus he writes in the "Natural History of Religion," with quite unusual acerbity:

"The chief objection to it [the ancient heathen mythology] with regard to this planet is, that it is not ascertained by any just reason or authority. The ancient tradition insisted on by heathen priests and theologers is but a weak foundation: and transmitted also such a number of contradictory reports, supported all of them by equal authority, that it became absolutely impossible to fix a preference among them. A few volumes, therefore, must contain all the polemical writings of pagan priests: And their whole theology must consist more of traditional stories and superstitious practices than of philosophical argument and controversy.

"But where theism forms the fundamental principle of any popular religion, that tenet is so conformable to sound reason, that philosophy is apt to incorporate itself with such a system of theology. And if the other dogmas of that system be contained in a sacred book, such as the Alcoran, or be determined by any visible authority, like that of the Roman pontiff, speculative reasoners naturally carry on their assent, and embrace a theory, which has been

instilled into them by their earliest education, and which also possesses some degree of consistence and uniformity. But as these appearances are sure, [168] all of them, to prove deceitful, philosophy will very soon find herself very unequally yoked with her new associate; and instead of regulating each principle, as they advance together, she is at every turn perverted to serve the purposes of superstition. For besides the unavoidable incoherences, which must be reconciled and adjusted, one may safely affirm, that all popular theology, especially the scholastic, has a kind of appetite for absurdity and contradiction. If that theology went not beyond reason and common sense, her doctrines would appear too easy and familiar. Amazement must of necessity be raised: Mystery affected: Darkness and obscurity sought after: And a foundation of merit afforded to the devout votaries, who desire an opportunity of subduing their rebellious reason by the belief of the most unintelligible sophisms.

"Ecclesiastical history sufficiently confirms these reflections. When a controversy is started, some people always pretend with certainty to foretell the issue. Whichever opinion, say they, is most contrary to plain reason is sure to prevail; even when the general interest of the system requires not that decision. Though the reproach of heresy may, for some time, be bandied about among the disputants, it always rests at last on the side of reason. Any one, it is pretended, that has but learning enough of this kind to know the definition of *Arian, Pelagian, Erastian, Socinian, Sabellian, Eutychian, Nestorian, Monothelite,* &c., not to mention *Protestant,* whose fate is yet uncertain, will be convinced of the truth of this observation. It is thus a system becomes absurd in the end, merely from its being reasonable and philosophical in the beginning.

"To oppose the torrent of scholastic religion by such feeble maxims as these, that it is *impossible for the same thing to be and not to be,* that *the whole is greater than a part,* that *two and three make five,* is pretending to stop the ocean with a bulrush. Will you set up profane reason against sacred mystery? No punishment is great enough for your impiety. And the same fires which were kindled for heretics will serve also for the destruction of philosophers."–(IV. pp. 481–3.)

Holding these opinions respecting the recognised [169] systems of theology and their professors, Hume, nevertheless, seems to have had a theology of his own; that is to say, he seems to have thought (though, as will appear, it is needful for an expositor of his opinions to speak very guardedly on this point) that the problem of theism is susceptible of scientific treatment, with something more than a negative result. His opinions are to be gathered from the eleventh section of the "Inquiry" (1748); from the "Dialogues concerning Natural Religion," which were written at least as early as 1751, though not published till after his death; and from the "Natural History of Religion," published in 1757.

In the first two pieces, the reader is left to judge for himself which interlocutor in the dialogue represents the thoughts of the author; but for the views put forward in the last, Hume accepts the responsibility. Unfortunately, this essay deals almost wholly with the historical development of theological ideas; and, on the question of the philosophical foundation of theology, does little more than express the writer's contentment with the argument from design.

"The whole frame of nature bespeaks an Intelligent Author; and no rational inquirer can, after serious reflection, suspend his belief a moment with regard to the primary principles of genuine Theism and Religion.–(IV. p. 435.)

"Were men led into the apprehension of invisible, intelligent power, by a contemplation of the works of nature, they could never possibly entertain any conception but of one [170] single being, who bestowed existence and

order on this vast machine, and adjusted all its parts according to one regular plan or connected system. For though, to persons of a certain turn of mind, it may not appear altogether absurd, that several independent beings, endowed with superior wisdom, might conspire in the contrivance and execution of one regular plan, yet is this a merely arbitrary supposition, which, even if allowed possible, must be confessed neither to be supported by probability nor necessity. All things in the universe are evidently of a piece. Everything is adjusted to everything. One design prevails throughout the whole. And this uniformity leads the mind to acknowledge one author because the conception of different authors, without any distinction of attributes or operations, serves only to give perplexity to the imagination, without bestowing any satisfaction on the understanding."–(IV. p. 442.)

Thus Hume appears to have sincerely accepted the two fundamental conclusions of the argument from design; firstly, that a Deity exists; and, secondly, that He possesses attributes more or less allied to those of human intelligence. But, at this embryonic stage of theology, Hume's progress is arrested; and, after a survey of the development of dogma, his "general corollary" is that–

"The whole is a riddle, an enigma, an inexplicable mystery. Doubt, uncertainty, suspense of judgment, appear the only result of our most accurate scrutiny concerning this subject. But such is the frailty of human reason and such the irresistible contagion of opinion, that even this deliberate doubt could scarcely be upheld; did we not enlarge our view, and opposing one species of superstition to another, set them a quarrelling; while we ourselves, during their fury and contention, happily make our escape into the calm, though obscure, regions of philosophy."–(IV. p. 513.)

[171] Thus it may be fairly presumed that Hume expresses his own sentiments in the words of the speech with which Philo concludes the "Dialogues."

"If the whole of natural theology, as some people seem to maintain, resolves itself into one simple, though somewhat ambiguous, at least undefined proposition, *That the cause or causes of order in the universe probably bear some remote analogy to human intelligence* : If this proposition be not capable of extension, variation, or more particular explication: If it affords no inference that affects human life or can be the source of any action or forbearance: And if the analogy, imperfect as it is, can be carried no further than to the human intelligence, and cannot be transferred, with any appearance of probability, to the other qualities of the mind; if this really be the case, what can the most inquisitive, contemplative, and religious man do more than give a plain, philosophical assent to the proposition, as often as it occurs, and believe that the arguments on which it is established exceed the objections which lie against it? Some astonishment indeed will naturally arise from the greatness of the object; some melancholy from its obscurity; some contempt of human reason, that it can give no solution more satisfactory with regard to so extraordinary and magnificent a question. But believe me, Cleanthes, the most natural sentiment which a well-disposed mind will feel on this occasion, is a longing desire and expectation that Heaven would be pleased to dissipate, at least alleviate, this profound ignorance, by affording some more particular revelation to mankind, and making discoveries of the nature, attributes, and operations of the Divine object of our faith."[2]–(II. pp. 547–8.)

[172] Such being the sum total of Hume's conclusions it cannot be said that his theological burthen is a heavy one. But, if we turn from the "Natural History of Religion," to the "Treatise," the "Inquiry," and the "Dialogues," the story of what happened to the ass laden with salt, who took to the water, irresistibly suggests itself. Hume's theism, such as it is, dissolves away in the dialectic river, until nothing is left but

the verbal sack in which it was contained.

Of the two theistic propositions to which Hume is committed, the first is the affirmation of the existence of a God, supported by the argument from the nature of causation. In the "Dialogues," Philo, while pushing scepticism to its utmost limit, is nevertheless made to say that–

".... where reasonable men treat these subjects, the question can never be concerning the *Being*, but only the *Nature* of the Deity. The former truth, as you will observe, is unquestionable and self-evident. Nothing exists without a cause, and the original cause of this universe (whatever it be) we call God, and piously ascribe to him every species of perfection."–(II. p. 439.)

The expositor of Hume, who wishes to do his work thoroughly, as far as it goes, cannot but fall [173] into perplexity[3] when he contrasts this language with that of the sections of the third part of the "Treatise," entitled, *Why a Cause is Always Necessary* and *Of the Idea of Necessary Connexion.*

It is there shown at large that, "every demonstration which has been produced for the necessity of a cause is fallacious and sophistical" (I. p. 111); it is affirmed, that "there is no absolute nor metaphysical necessity that every beginning of existence should be attended with such an object" [as a cause] (I. p. 227); and it is roundly asserted, that [174] it is "easy for us to conceive any object to be nonexistent this moment and existent the next, without conjoining to it the distinct idea of a cause or productive principle" (I. p. 111). So far from the axiom, that whatever begins to exist must have a cause of existence, being "self-evident," as Philo calls it, Hume spends the greatest care in showing that it is nothing but the product of custom, or experience.

And the doubt thus forced upon one, whether Philo ought to be taken as Hume's mouthpiece even so far, is increased when we reflect that we are dealing with an acute reasoner; and that there is no difficulty in drawing the deduction from Hume's own definition of a cause, that the very phrase, a "first cause," involves a contradiction in terms. He lays down that,–

"'Tis an established axiom both in natural and moral philosophy, that an object, which exists for any time in its full perfection without producing another, is not its sole cause; but is assisted by some other principle which pushes it from its state of inactivity, and makes it exert that energy, of which it was secretly possessed."–(I. p. 106.)

Now the "first cause" is assumed to have existed from all eternity, up to the moment at which the universe came into existence. Hence it cannot be the sole cause of the universe; in fact, it was no cause at all until it was "assisted by some other principle"; consequently the so-called "first cause," so far as it produces the universe, [175] is in reality an effect of that other principle. Moreover, though, in the person of Philo, Hume assumes the axiom "that whatever begins to exist must have a cause," which he denies in the "Treatise," he must have seen, for a child may see, that the assumption is of no real service.

Suppose Y to be the imagined first cause and Z to be its effect. Let the letters of the alphabet, *a, b, c, d,*

e, f, g, in their order, represent successive moments of time, and let *g* represent the particular moment at which the effect Z makes its appearance. It follows that the cause Y could not have existed "in its full perfection" during the time *a–e,* for if it had, then the effect Z would have come into existence during that time, which, by the hypothesis, it did not do. The cause Y, therefore, must have come into existence at *f,* and if "everything that comes into existence has a cause," Y must have had a cause X operating at *e,* X a cause W operating at *d;* and so on, *ad infinitum.*[4]

If the only demonstrative argument for the existence of a Deity, which Hume advances, thus literally, "goes to water" in the solvent of his philosophy, the reasoning from the evidence of design does not fare much better. If Hume really [176] knew of any valid reply to Philo's arguments in the following passages of the "Dialogues," he has dealt unfairly by the reader in concealing it:–

"But because I know you are not much swayed by names and authorities, I shall endeavour to show you, a little more distinctly, the inconveniences of that Anthropomorphism, which you have embraced; and shall prove that there is no ground to suppose a plan of the world to be formed in the Divine mind, consisting of distinct ideas, differently arranged, in the same manner as an architect forms in his head the plan of a house which he intends to execute.

"It is not easy, I own, to see what is gained by this supposition, whether we judge the matter by *Reason* or by *Experience* . We are still obliged to mount higher in order to find the cause of this cause, which you had assigned as satisfactory and conclusive.

"If *Reason* (I mean abstract reason, derived from inquiries a *priori*) be not alike mute with regard to all questions concerning cause and effect, this sentence at least it will venture to pronounce: That a mental world, or universe of ideas, requires a cause as much as does a material world or universe of objects; and, if similar in its arrangement, must require a similar cause. For what is there in this subject, which should occasion a different conclusion or inference? In an abstract view they are entirely alike; and no difficulty attends the one supposition, which is not common to both of them.

"Again, when we will needs force *Experience* to pronounce some sentence, even on those subjects which lie beyond her sphere, neither can she perceive any material difference in this particular, between these two kinds of worlds; but finds them to be governed by similar principles, and to depend upon an equal variety of causes in their operations. We have specimens in miniature of both of them. Our own mind resembles the one; a vegetable or animal body the other. Let experience, therefore, judge from these samples. Nothing seems more delicate, with regard to its causes, than thought: and as these causes never operate in two persons after the same manner, so [177] we never find two persons who think exactly alike. Nor indeed does the same person think exactly alike at any two different periods of time. A difference of age, of the disposition of his body, of weather, of food, of company, of books, of passions; any of these particulars, or others more minute, are sufficient to alter the curious machinery of thought, and communicate to it very different movements and operations. As far as we can judge, vegetables and animal bodies are not more delicate in their motions, nor depend upon a greater variety or more curious adjustment of springs and principles.

"How, therefore, shall we satisfy ourselves concerning the cause of that Being whom you suppose the Author of Nature or, according to your system of anthropomoirphism [sic], the ideal world in which you trace the material?

Have we not the same reason to trace the ideal world into another ideal world, or new intelligent principle But if we stop and go no farther; why go so far? Why not stop at the material world? How can we satisfy ourselves without going on *ad infinitum*? And after all, what satisfaction is there in that infinite progression? Let us remember the story of the Indian philosopher and his elephant. It was never more applicable than to the present subject. If the material world rests upon a similar ideal world, this ideal world must rest upon some other; and so on without end. It were better, therefore, never to look beyond the present material world. By supposing it to contain the principle of its order within itself, we really assert it to be God; and the sooner we arrive at that Divine Being, so much the better. When you go one step beyond the mundane system you only excite an inquisitive humour, which it is impossible ever to satisfy.

"To say, that the different ideas which compose the reason of the Supreme Being, fall into order of themselves and by their own natures, is really to talk without any precise meaning. If it has a meaning, I would fain know why it is not as good sense to say, that the parts of the material world fall into order of themselves, and by their own nature. Can the one opinion be intelligible while the other is not so?"–(II. pp. 461–4.)

[178] Cleanthes, in replying to Philo's discourse, says that it is very easy to answer his arguments; but, as not unfrequently happens with controversialists, he mistakes a reply for an answer, when he declares that–

"The order and arrangement of nature, the curious adjustment of final causes, the plain use and intention of every part and organ; all these bespeak in the clearest language one intelligent cause or author. The heavens and the earth join in the same testimony. The whole chorus of nature raises one hymn to the praises of its Creator."–(II. p. 465.)

Though the rhetoric of Cleanthes may be admired, its irrelevancy to the point at issue must be admitted. Wandering still further into the region of declamation, he works himself into a passion:

"You alone, or almost alone, disturb this general harmony. You start abstruse doubts, cavils, and objections: You ask me what is the cause of this cause? I know not: I care not: that concerns not me. I have found a Deity; and here I stop my inquiry. Let those go further who are wiser or more enterprising."–(II. p. 466.)

In other words, O Cleanthes, reasoning having taken you as far as you want to go, you decline to advance any further; even though you fully admit that the very same reasoning forbids you to stop where you are pleased to cry halt! But this is simply forcing your reason to abdicate in favour of your caprice. It is impossible to imagine that Hume, of all men in the world, [179] could have rested satisfied with such an act of high-treason against the sovereignty of philosophy. We may rather conclude that the last word of the discussion, which he gives to Philo, is also his own.

"If I am still to remain in utter ignorance of causes, and can absolutely give an explication of nothing, I shall never esteem it any advantage to shove off for a moment a difficulty, which, you acknowledge, must immediately, in its full force, recur upon me. Naturalists[5] indeed very justly explain particular effects by more general causes, though these general causes should remain in the end totally inexplicable; but they never surely thought it satisfactory to explain a particular effect by a particular cause, which was no more to be accounted for than the effort itself. An ideal system, arranged of itself, without a precedent design, is not a whit more explicable

than a material one, which attains its order in a like manner; nor is there any more difficulty in the latter supposition than in the former."–(II. p. 466.)

It is obvious that, if Hume had been pushed, he must have admitted that his opinion concerning the existence of a God, and of a certain remote resemblance of his intellectual nature to that of man, was an hypothesis which might possess more or less probability, but, on his own principles, was incapable of any approach to demonstration. And to all attempts to make any practical use of his theism; or to prove the existence of the attributes of infinite wisdom, benevolence, justice, and the like, which are usually ascribed to the [180] Deity, by reason, he opposes a searching critical negation.[6]

The object of the speech of the imaginary Epicurean in the eleventh section of the "Inquiry," entitled "Of a Particular Providence and of a Future State," is to invert the argument of Bishop Butler's "Analogy."

That famous defence of theology against the *a priori* scepticism of Freethinkers of the eighteenth century, who based their arguments on the inconsistency of the revealed scheme of salvation with the attributes of the Deity, consists, essentially, in conclusively proving that, from a moral point of view, Nature is at least as reprehensible as orthodoxy. If you tell me, says Butler, in effect, that any part of revealed religion must be false because it is inconsistent with the divine attributes of justice and mercy; I beg leave to point out to you, that there are undeniable natural facts which are fully open to the same objection. Since you admit that nature is the work of God, you are forced to allow that such facts are consistent with his attributes. Therefore, you must also admit, that the parallel facts in the scheme of orthodoxy are also consistent with them, and all your arguments to the contrary fall to the ground. Q.E. D. In fact, the [181] solid sense of Butler left the Deism of the Freethinkers not a leg to stand upon. Perhaps, however, he did not remember the wise saying that "A man seemeth right in his own cause, but another cometh after and judgeth him." Hume's Epicurean philosopher adopts the main arguments of the "Analogy," but unfortunately drives them home to a conclusion of which the good Bishop would hardly have approved.

"I deny a Providence, you say, and supreme governor of the world, who guides the course of events, and punishes the vicious with infamy and disappointment, and rewards the virtuous with honour and success in all their undertakings. But surely I deny not the course itself of events which lies open to every one's inquiry and examination I acknowledge that, in the present order of things, virtue is attended with more peace of mind than vice, and meets with a more favourable reception from the world. I am sensible that, according to the past experience of mankind, friendship is the chief joy of human life, and moderation the only source of tranquillity and happiness. I never balance between the virtuous and the vicious course of life; but am sensible that, to a well-disposed mind, every advantage is on the side of the former. And what can you say more, allowing all your suppositions and reasonings? You tell me, indeed, that this disposition of things proceeds from intelligence and design. But, whatever it proceeds from, the disposition itself, on which depends our happiness and misery, and consequently our conduct and deportment in life, is still the same. It is still open for me, as well as you, to regulate my behaviour by my experience of past events. And if you affirm that, while a divine providence is allowed, and a supreme distributive justice in the universe, I ought to expect some more particular reward of the good, and punishment of the bad, beyond the ordinary course of events, I here find the same fallacy which I have before endeavoured [182] to detect. You persist in imagining, that if we grant that divine existence for which you so earnestly contend, you may safely infer consequences from it, and add something to the experienced order of

nature by arguing from the attributes which you ascribe to your gods. You seem not to remember that all your reasonings on this subject can only be drawn from effects to causes; and that every argument, deduced from causes to effects, must of necessity be a gross sophism, since it is impossible for you to know anything of the cause, but what you have antecedently not inferred, but discovered to the full, in the effect.

"But what must a philosopher think of those vain reasoners who, instead of regarding the present scene of things as the sole object of their contemplation, so far reverse the whole course of nature, as to render this life merely a passage to something further; a porch, which leads to a greater and vastly different building; a prologue which serves only to introduce the piece, and give it more grace and propriety? Whence, do you think, can such philosophers derive their idea of the gods? From their own conceit and imagination surely. For if they derive it from the present phenomena, it would never point to anything further, but must be exactly adjusted to them. That the divinity may *possibly* be endowed with attributes which we have never seen exerted; may be governed by principles of action which we cannot discover to be satisfied; all this will freely be allowed. But still this is mere *possibility* and hypothesis. We never can have reason to infer any attributes or any principles of action in him, but so far as we know them to have been exerted and satisfied.

"Are there any marks of distributive justice in the world? If you answer in the affirmative, I conclude that since justice here exerts itself, it is satisfied. If you reply in the negative, I conclude that you have then no reason to ascribe justice, in our sense of it, to the gods. If you hold a medium between affirmation and negation, by saying that the justice of the gods at present exerts itself in part, but not in its full extent, I answer that you have no reason to give it any particular extent, but only so far as you see it, at *present*, exert itself" (IV pp. 164–6.)

[183] Thus, the Freethinkers said, the attributes of the Deity being what they are, the scheme of orthodoxy is inconsistent with them; whereupon Butler gave the crushing reply: Agreeing with you as to the attributes of the Deity, nature, by its existence, proves that the things to which you object are quite consistent with them. To whom enters Hume's Epicurean with the remark: Then, as nature is our only measure of the attributes of the Deity in their practical manifestation, what warranty is there for supposing that such measure is anywhere transcended? That the "other side" of nature, if there be one, is governed on different principles from this side?

Truly on this topic silence is golden; while speech reaches not even the dignity of sounding brass or tinkling cymbal, and is but the weary clatter of an endless logomachy. One can but suspect that Hume also had reached this conviction; and that his shadowy and inconsistent theism was the expression of his desire to rest in a state of mind, which distinctly excluded negation, while it included as little as possible of affirmation, respecting a problem which he felt to be hopelessly insoluble.

But, whatever might be the views of the philosopher as to the arguments for theism, the historian could have no doubt respecting its many-shaped existence, and the great part which it has played in the world. Here, then, was a [184] body of natural facts to be investigated scientifically, and the result of Hume's inquiries is embodied in the remarkable essay on the "Natural History of Religion." Hume anticipated the results of modern investigation in declaring fetishism and polytheism to be the form in which savage and ignorant men naturally clothe their ideas of the unknown influences which govern their destiny; and they are polytheists rather than monotheists because,–

". . . The first ideas of religion arose, not from a contemplation of the works of nature, but from a concern with regard to the events of life, and from the incessant hopes and fears which actuate the human mind.... in order to carry men's attention beyond the present course of things, or lead them into any inference concerning invisible intelligent power, they must be actuated by some passion which prompts their thought and reflection, some motive which urges their first enquiry. But what passion shall we have recourse to, for explaining an effect of such mighty consequence? Not speculative curiosity merely, or the pure love of truth. That motive is too refined for such gross apprehensions, and would lead men into enquiries concerning the frame of nature, a subject too large and comprehensive for their narrow capacities. No passions, therefore, can be supposed to work on such barbarians, but the ordinary affections of human life; the anxious concern for happiness, the dread of future misery, the terror of death, the thirst of revenge, the appetite for food and other necessaries. Agitated by hopes and fears of this nature, especially the latter, men scrutinize, with a trembling curiosity, the course of future causes, and examine the various and contrary events of human life. And in this disordered scene, with eyes still more disordered and astonished, they see the first obscure traces of divinity."–(IV. pp. 443-4.)

[185] The shape assumed by these first traces of divinity is that of the shadows of men's own minds, projected out of themselves by their imaginations:–

"There is an universal tendency among mankind to conceive all beings like themselves, and to transfer to every object those qualities with which they are familiarly acquainted, and of which they are intimately conscious.... The *unknown causes* which continually employ their thought, appearing always in the same aspect, are all apprehended to be of the same kind or species. Nor is it long before we ascribe to them thought, and reason, and passion, and sometimes even the limbs and figures of men in order to bring them nearer to a resemblance with ourselves. "–(IV. pp. 446–7.)

Hume asks whether polytheism really deserves the name of theism.

"Our ancestors in Europe, before the revival of letters, believed as we do at present, that there was one supreme God, the author of nature, whose power, though in itself uncontrollable, was yet often exerted by the interposition of his angels and subordinate ministers, who executed his sacred purposes. But they also believed, that all nature was full of other invisible powers: fairies, goblins, elves, sprights; beings stronger and mightier than men, but much inferior to the celestial natures who surround the throne of God. Now, suppose that any one, in these ages, had denied the existence of God and of his angels, would not his impiety justly have deserved the appellation of atheism, even though he had still allowed, by some odd capricious reasoning, that the popular stories of elves and fairies were just and well grounded? The difference, on the one hand, between such a person and a genuine theist, is infinitely greater than that, on the other, between him and one that absolutely excluded all invisible intelligent power. And it is a fallacy, merely from the casual resemblance of names, without any [186] conformity of meaning, to rank such opposite opinions under the same denomination.

"To any one who considers justly of the matter, it will appear that the gods of the polytheists are no better than the elves and fairies of our ancestors, and merit as little as any pious worship and veneration. These pretended religionists are really a kind of superstitious atheists, and acknowledge no being that corresponds to our idea of a Deity. No first principle of mind or thought; no supreme government and administration; no divine contrivance or intention in the fabric of the world."–(IV. pp. 450–61.)

The doctrine that you may call an atheist anybody whose ideas about the Deity do not correspond with

your own, is so largely acted upon by persons who are certainly not of Hume's way of thinking and, probably, so far from having read him, would shudder to open any book bearing his name, except the "History of England," that it is surprising to trace the theory of their practice to such a source.

But on thinking the matter over, this theory seems so consonant with reason, that one feels ashamed of having suspected many excellent persons of being moved by mere malice and viciousness of temper to call other folks atheists, when, after all, they have been obeying a purely intellectual sense of fitness. As Hume says, truly enough, it is a mere fallacy, because two people use the same names for things, the ideas of which are mutually exclusive, to rank such opposite opinions under the same denomination. If the [187] Jew says, that the Deity is absolute unity, and that it is sheer blasphemy to say that He ever became incarnate in the person of a man; and, if the Trinitarian says, that the Deity is numerically three as well as numerically one, and that it is sheer blasphemy to say that He did not so become incarnate, it is obvious enough that each must be logically held to deny the existence of the other's Deity. Therefore; that each has a scientific right to call the other an atheist; and that, if he refrains, it is only on the ground of decency and good manners, which should restrain an honourable man from employing even scientifically justifiable language, if custom has given it an abusive connotation. While one must agree with Hume, then, it is, nevertheless, to be wished that he had not set the bad example of calling polytheists "superstitious atheists." It probably did not occur to him that, by a parity of reasoning, the Unitarians might justify the application of the same language to the Ultramontanes, and *vice versâ* . But, to return from a digression which may not be wholly unprofitable, Hume proceeds to show in what manner polytheism incorporated physical and moral allegories, and naturally accepted hero-worship; and he sums up his views of the first stages of the evolution of theology as follows:–

"These then are the general principles of polytheism, founded in human nature, and little or nothing dependent on caprice or [188] accident. As the causes which bestow happiness or misery, are in general very little known and very uncertain, our anxious concern endeavours to attain a determinate idea of them; and finds no better expedient than to represent them as intelligent, voluntary agents, like ourselves, only somewhat superior in power and wisdom. The limited influence of these agents, and their proximity to human weakness, introduce the various distribution and division of their authority, and thereby give rise to allegory. The same principles naturally deify mortals, superior in power, courage, or understanding, and produce hero-worship; together with fabulous history and mythological tradition, in all its wild and unaccountable forms. And as an invisible spiritual intelligence is an object too refined for vulgar apprehension, men naturally affix it to some sensible representation; such as either the more conspicuous parts of nature, or the statues, images, and pictures, which a more refined age forms of its divinities."–(IV. p. 461.)

How did the further stage of theology, monotheism, arise out of polytheism? Hume replies, certainly not by reasonings from first causes or any sort of fine-drawn logic:–

"Even at this day, and in Europe, ask any of the vulgar why he believes in an Omnipotent Creator of the world, he will never mention the beauty of final causes, of which he is wholly ignorant: He will not hold out his hand and bid you contemplate the suppleness and variety of joints in his fingers, their bending all one way, the counterpoise which they receive from the thumb, the softness and fleshy parts of the inside of the hand, with all the other circumstances which render that member fit for the use to which it was destined. To these he has been long accustomed; and he beholds them with listlessness and unconcern. He will tell you of the sudden and

unexpected death of such-a-one; the fall and bruise of such another; the excessive drought of this season; the cold and rains of another. These he ascribes to the immediate operation of Providence: And such [189] events as, with good reasoners, are the chief difficulties in admitting a Supreme Intelligence, are with him the sole arguments for it....

"We may conclude therefore, upon the whole, that since the vulgar, in nations which have embraced the doctrine of theism, still build it upon irrational and superstitious grounds, they are never led into that opinion by any process of argument, but by a certain train of thinking, more suitable to their genius and capacity.

"It may readily happen, in an idolatrous nation, that though men admit the existence of several limited deities, yet there is some one God, whom, in a particular manner, they make the object of their worship and adoration. They may either suppose, that, in the distribution of power and territory among the gods, their nation was subjected to the jurisdiction of that particular deity; or, reducing heavenly objects to the model of things below, they may represent one god as the prince or supreme magistrate of the rest, who, though of the same nature, rules them with an authority like that which an earthly sovereign exerts over his subjects and vassals. Whether this god, therefore, be considered as their peculiar patron, or as the general sovereign of heaven, his votaries will endeavour, by every art, to insinuate themselves into his favour; and supposing him to be pleased, like themselves, with praise and flattery, there is no eulogy or exaggeration which will be spared in their addresses to him. In proportion as men's fears or distresses become more urgent, they still invent new strains of adulation; and even he who outdoes his predecessor in swelling the titles of his divinity, is sure to be outdone by his successor in newer and more pompous epithets of praise. Thus they proceed, till at last they arrive at infinity itself, beyond which there is no further progress; And it is well if, in striving to get further, and to represent a magnificent simplicity, they run not into inexplicable mystery, and destroy the intelligent nature of their deity, on which alone any rational worship or adoration can be founded. While they confine themselves to the notion of a perfect being, the Creator of the world, they coincide, by chance, with the principles of reason and true philosophy; though they [190] are guided to that notion, not by reason, of which they are in a great measure incapable, but by the adulation and fears of the most vulgar superstition."–(IV. pp. 463-6.)

"Nay, if we should suppose, what never happens, that a popular religion were found, in which it was expressly declared, that nothing but morality could gain the divine favour; if an order of priests were instituted to inculcate this opinion, in daily sermons, and with all the arts of persuasion; yet so inveterate are the people's prejudices, that, for want of some other superstition they would make the very attendance on these sermons the essentials of religion, rather than place them in virtue and good morals. The sublime prologue of Zaleucus' laws inspired not the Locrians, so far as we can learn, with any sounder notions of the measures of acceptance with the deity, than were familiar to the other Greeks."–(IV. p. 605.)

It has been remarked that Hume's writings are singularly devoid of local colour; of allusions to the scenes with which he was familiar, and to the people from whom he sprang. Yet, surely, the Lowlands of Scotland were more in his thoughts than the Zephyrean promontory, and the hard visage of John Knox peered from behind the mask of Zaleucus, when this passage left his pen. Nay, might not an acute German critic discern therein a reminiscence of that eminently Scottish institution, a "Holy Fair"? where, as Hume's young contemporary sings:–

" * * * opens out his cauld harangues
On practice and on morals;

An' aff the godly pour in thrangs
To gie the jars and barrels
A lift that day.

[191] "What signifies his barren shine
Of moral powers and reason?
His English style and gesture fine
Are a' clean out of season.
Like Socrates or Antonine,
Or some auld pagan heathen,
The moral man he does define,
But ne'er a word o' faith in
That's right that day."[7]

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[1] In a note to the Essay on Superstition and Enthusiasm, Hume is careful to define what he means by this term. "By priests I understand only the pretenders to power and dominion, and to a superior sanctity of character, distinct from virtue and good morals. These are very different from *clergymen*, who are set apart to the care of sacred matters, and the conducting our public devotions with greater decency and order. There is no rank of men more to be respected than the latter."–(III. p. 83)

[2] It is needless to quote the rest of the passage, though I cannot refrain from observing that the recommendation which it contains that a "man of letters" should become a philosophical sceptic as "the first and most essential step towards being a sound believing Christian," though adopted and largely acted upon by many a champion of orthodoxy in these days, is questionable in taste, if it be meant as a jest, and more than questionable in morality, if it is to be taken in earnest. To pretend that you believe any doctrine for no better reason than that you doubt everything else, would be dishonest, if it were not preposterous.

[3] A perplexity which is increased rather than diminished by some passages in a letter to Gilbert Elliot of Minto (March 10, 1761). Hume says, "You would perceive by the sample I have given you that I make Cleanthes the hero of the dialogue; whatever you can think of, to strengthen that side of the argument, will be most acceptable to me. Any propensity you imagine I have to the other side crept in upon me against my will; and 'tis not long ago that I burned an old manuscript book, wrote before I was twenty, which contained, page after page, the gradual progress of my thoughts on this head. It began with an anxious scent after arguments to confirm the common opinion; doubts stole in, dissipated, returned, were again dissipated, returned again; and it was a perpetual struggle of a restless imagination against inclination–perhaps against reason.... I could wish Cleanthes' argument could be so analysed as to be rendered quite formal and regular. The propensity of the mind towards it–unless that propensity were as strong and universal as that to believe in our senses and experience–will still, I am afraid, be esteemed a suspicious foundation. 'Tis here I wish for your assistance. We must endeavour to prove that this propensity is somewhat different from our inclination to find our own figures in the clouds, our faces in the moon, our passions and sentiments even in inanimate matter. Such an inclination may and ought to be controlled, and can never be a legitimate ground of assent." (Burton, *Life*, I. pp. 331–3.) The picture of Hume here drawn unconsciously by his own hand, is unlike enough to the popular conception of him as a careless

sceptic, loving doubt for doubt's sake.

[4] Kant employs substantially the same argument:–"Würde das höchste Wesen in dieser Kette der Bedingungen stehen, so wirde es selbst ein Glied der Reihe derselben sein, und eben so wie die niederen Glieder, denen es vorgesetzt ist, noch fernere Untersuchungen wegen seines noch höheren Grundes erfahren." –*Kritik.* Ed. Hartenstein, p. 422

[5] *I.e.* Natural philosophers.

[6] Hume's letter to Mure of Caldwell, containing a criticism of Leechman's sermon (Burton, I. p. 163), bears strongly on this point.

[7] Burns published the *Holy Fair* only ten years after Hume's death.

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[192] Chapter IX

The Soul: The Docrtine of Immorality

Descartes taught that an absolute difference of kind separates matter, as that which possesses extension, from spirit, as that which thinks. They not only have no character in common, but it is inconceivable that they should have any. On the assumption, that the attributes of the two were wholly different, it appeared to be a necessary consequence that the hypothetical causes of these attributes–their respective substances–must be totally different. Notably, in the matter of divisibility, since that which has no extension cannot be divisible, it seemed that the *chose pensante*, the soul, must be an indivisible entity.

Later philosophers, accepting this notion of the soul, were naturally much perplexed to understand how, if matter and spirit had nothing in common, they could act and react on one another. All the changes of matter being modes of motion, [193] the difficulty of understanding how a moving extended material body was to affect a thinking thing which had no dimension, was as great as that involved in solving the problem of how to hit a nominative case with a stick. Hence, the successors of Descartes either found themselves obliged, with the Occasionalists, to call in the aid of the Deity, who was supposed to be a sort of go-between betwixt matter and spirit; or they had recourse, with Leibnitz, to the doctrine of pre-established harmony, which denied any influence of the body on the soul, or *vice versâ*, and compared matter and spirit to two clocks so accurately regulated to keep time with one another, that the one struck whenever the other pointed to the hour; or, with Berkeley, they abolished the "substance" of matter altogether, as a superfluity, though they failed to see that the same arguments equally justified the abolition of soul as another superfluity, and the reduction of the universe to a series of events or phenomena; or, finally, with Spinoza, to whom Berkeley makes a perilously close approach, they asserted the existence of only one substance, with two chief attributes, the one, thought, and the other, extension.

There remained only one possible position, which, had it been taken up earlier, might have saved an immensity of trouble; and that was to affirm that we do not, and cannot, know anything about the [194] "substance" either of the thinking thing, or of the extended thing. And Hume's sound common sense led him to defend the thesis which Locke had already foreshadowed, with respect to the question of the substance of the soul. Hume enunciates two opinions. The first is that the question itself is unintelligible, and therefore cannot receive any answer; the second is that the popular doctrine respecting the immateriality, simplicity, and indivisibility of a thinking substance is a "true atheism, and will serve to justify all those sentiments for which Spinoza is so universally infamous."

In support of the first opinion, Hume points out that it is impossible to attach any definite meaning to the word "substance" when employed for the hypothetical substratum of soul and matter. For if we define substance as that which may exist by itself, the definition does not distinguish the soul from perceptions. It is perfectly easy to conceive that states of consciousness are self-subsistent, And, if the substance of the soul is defined as that in which perceptions inhere, what is meant by the inherence? Is such inherence conceivable? If conceivable, what evidence is there of it? And what is the use of a substratum to things which, for anything we know to the contrary, are capable of existing by themselves?

Moreover, it may be added, supposing the soul has a substance, how do we know that it is differ[195]ent from the substance, which, on like grounds, must be supposed to underlie the qualities of matter?

Again, if it be said that our personal identity requires the assumption of a substance which remains the same while the accidents of perception shift and change, the question arises what is meant by personal identity?

"For my part," says Hume, "when I enter most intimately into what I call *myself,* I always stumble on some particular perception or other, of heat or cold, light or shade, love or hatred, pain or pleasure. I never can catch *myself* at any time without a perception, and never can observe anything but the perception. When my perceptions are removed for any time, as by sound sleep, so long am I insensible of *myself,* and may be truly said not to exist. And were all my perceptions removed by death, and I could neither think, nor feel, nor see, nor love, nor hate, after the dissolution of my body, I should be entirely annihilated, nor do I conceive what is further requisite to make me a perfect nonentity. If any one, upon serious and unprejudiced reflection, thinks he has a different notion of *himself,* I must confess I can reason no longer with him. All I can allow him is, that he maybe in the right as well as I, and that we are essentially different in this particular. He may perhaps perceive something simple and continued which he calls *himself,* though I am certain there is no such principle in me.

"But setting aside some metaphysicians of this kind, I may venture to affirm of the rest of mankind, that they are nothing but a bundle or collection of different perceptions, which succeed one another with an inconceivable rapidity, and are in a perpetual flux and movement.... The mind is a kind of theatre, where several perceptions successively make their appearance, pass, repass, glide away, and mingle in an infinite variety of postures and situations. There is properly no [196] *simplicity* in it at one time, nor *identity* in different, whatever natural propension we may have to imagine that simplicity and identity. The comparison of the theatre must not mislead us. They are the successive perceptions only that constitute the mind; nor have we the most distant notion of the place where these scenes are represented, or of the materials of which it is composed.

"What then gives so great a propension to ascribe an identity to these successive perceptions, and to suppose ourselves possessed of an invariable and uninterrupted existence through the whole course of our lives? In order to answer this question, we must distinguish between personal identity as it regards our thought and imagination, and as it regards our passions, or the concern we take in ourselves. The first is our present subject; and to explain it perfectly we must take the matter pretty deep, and account for that identity which we attribute to plants and animals; there being a great analogy betwixt it and the identity of a self or person."–(I. pp. 321, 322.)

Perfect identity is exhibited by an object which remains unchanged throughout a certain time; perfect diversity is seen in two or more objects which are separated by intervals of space and periods of time. But, in both these cases, there is no sharp line of demarcation between identity and diversity, and it is impossible to say when an object ceases to be one and becomes two.

When a sea-anemone multiplies, by division, there is a time during which it is said to be one animal partially divided; but after a while, it becomes two animals adherent together, and the limit between these conditions is purely arbitrary. [197] So in mineralogy, a crystal of a definite chemical composition may have its substance replaced, particle by particle, by another chemical compound. When does it lose its primitive identity and become a new thing?

Again, a plant or an animal, in the course of its existence, from the condition of an egg or seed to the end of life, remains the same neither in form, nor in structure, nor in the matter of which it is composed: every attribute it possesses is constantly changing, and yet we say that it is always one and the same individual. And if, in this case, we attribute identity without supposing an indivisible immaterial something to underlie and condition that identity, why should we need the supposition in the case of that succession of changeful phenomena we call the mind?

In fact, we ascribe identity to an individual plant or animal, simply because there has been no moment of time at which we could observe any division of it into parts separated by time or space. Every experience we have of it is as one thing and not as two; and we sum up our experiences in the ascription of identity, although we know quite well that, strictly speaking, it has not been the same for any two moments.

So with the mind. Our perceptions flow in even succession; the impressions of the present moment are inextricably mixed up with the memories of yesterday and the expectations of [198] to-morrow, and all are connected by the links of cause and effect.

". . . . as the same individual republic may not only change its members, but also its laws and constitutions; in like manner the same person may vary his character and disposition, as well as his impressions and ideas, without losing his identity. Whatever changes he endures, his several parts are still connected by the relation of causation. And, in this view our identity with regard to the passions serves to corroborate that with regard to the imagination, by the making our distant perceptions influence each other, and by giving us a present concern for our past or future pains or pleasures.

"As memory alone acquaints us with the continuance and extent of this succession of perceptions, 'tis to be

considered, upon that account chiefly, as the source of personal identity. Had we no memory we never should have any notion of causation, nor consequently of that chain of causes and effects which constitute our self or person. But having once acquired this notion of causation from the memory, we can extend the same chain of causes, and consequently the identity of our persons, beyond our memory, and can comprehend times, and circumstances, and actions, which we have entirely forgot, but suppose in general to have existed. For how few of our past actions are there of which we have any memory? Who can tell me, for instance, what were his thoughts and actions on the first of January, 1716, the eleventh of March, 1719, and the third of August, 1733? Or will he affirm, because he has entirely forgot the incidents of those days, that the present self is not the same person with the self of that time, and by that means overturn all the most established notions of personal identity? In this view, therefore, memory does not so much *produce* as *discover* personal identity, by showing us the relation of cause and effect among our different perceptions. 'Twill be incumbent on those who affirm that memory produces entirely our personal identity, to give a reason why we can thus extend our identity beyond our memory.

"The whole of this doctrine leads us to a conclusion which [199] is of great importance in the present affair, viz. that all the nice and subtle questions concerning personal identity can never possibly be decided, and are to be regarded rather as grammatical than as philosophical difficulties. Identity depends on the relations of ideas, and these relations produce identity by means of that easy transition they occasion. But as the relations, and the easiness of the transition may diminish by insensible degrees, we have no just standard by which we can decide any dispute concerning the time when they acquire or lose a title to the name of identity. All the disputes concerning the identity of connected objects are merely verbal, except so far as the relation of parts gives rise to some fiction or imaginary principle of union, as we have already observed.

"What I have said concerning the first origin and uncertainty of our notion of identity, as applied to the human mind, may be extended, with little or no variation, to that of *simplicity.* An object, whose different co-existent parts are bound together by a close relation, operates upon the imagination after much the same manner as one perfectly simple and undivisible, and requires not a much greater stretch of thought in order to its conception. From this similarity of operation we attribute a simplicity to it, and feign a principle of union as the support of this simplicity, and the centre of all the different parts and qualities of the object."–(I. pp. 331-3.)

The final result of Hume's reasoning comes to this: As we use the name of body for the sum of the phenomena which make up our corporeal existence, so we employ the name of soul for the sum of the phenomena which constitute our mental existence; and we have no more reason, in the latter case, than in the former, to suppose that there is anything beyond the phenomena which answers to the name. In the case of the soul, as in that of the body, the idea of substance is a [200] mere fiction of the imagination. This conclusion is nothing but a rigorous application of Berkeley's reasoning concerning matter to mind, and it is fully adopted by Kant.[1]

Having arrived at the conclusion that the conception of a soul, as a substantive thing, is a mere figment of the imagination; and that, whether it exists or not, we can by no possibility know anything about it, the inquiry as to the durability of the soul may seem superfluous.

Nevertheless, there is still a sense in which, even under these conditions, such an inquiry is justifiable, Leaving aside the problem of the substance of the soul, and taking the word "soul" simply as a name for

the series of mental phenomena which make up an individual mind; it remains open to us to ask, whether that series commenced with, or before, the series of phenomena which constitute the corresponding individual body; and whether it terminates with the end of the corporeal series, or goes on after the existence of the body has ended, And, in both cases, there arises the further question, whether the excess of duration of the mental series over that of the body, is finite or infinite.

[201] Hume has discussed some of these questions in the remarkable essay "On the Immortality of the Soul," which was not published till after his death, and which seems long to have remained but little known. Nevertheless, indeed, possibly, for that reason, its influence has been manifested in unexpected quarters, and its main arguments have been adduced by archiepiscopal and episcopal authority in evidence of the value of revelation. Dr. Whately,[2] sometime Archbishop of Dublin, paraphrases Hume, though he forgets to cite him; and Bishop Courtenay's elaborate work,[3] dedicated to the Archbishop, is a development of that prelate's version of Hume's essay.

This little piece occupies only some ten pages, but it is not wonderful that it attracted an acute logician like Whately, for it is a model of clear and vigorous statement. The argument hardly admits of condensation, so that I must let Hume speak for himself:–

"By the mere light of reason it seems difficult to prove the immortality of the soul: the arguments for it are commonly derived either from metaphysical topics, or moral, or physical. [202] But in reality it is the gospel, and the gospel alone, that has brought *life and immortality* to light.[4]

"1. Metaphysical topics suppose that the soul is immaterial, and that 'tis impossible for thought to belong to a material substance.[5] But just metaphysics teach us that the notion of substance is wholly confused and imperfect; and that we have no other idea of any substance, than as an aggregate of particular qualities inhering in an unknown something. Matter, therefore, and spirit, are at bottom equally unknown, and we cannot determine what qualities inhere in the one or in the other.[6] They likewise teach us that nothing can be decided *a priori* concerning any cause or effect; and that experience, being the only source of our judgments of this nature, we cannot know from any other principle, whether matter, by its structure or arrangement, may not be the cause of thought. Abstract reasonings cannot decide any question of fact or existence. But admitting a spiritual substance to be dispersed throughout the universe, like the ethereal fire of the Stoics, and to be the only inherent subject of thought, we have reason to conclude from *analogy*, that nature uses it after the manner she does the other substance, *matter.* She employs it as s kind of paste or clay; modifies it into a variety of forms [203] or existences; dissolves after a time each modification, and from its substance erects a new form. As the same material substance may successively compose the bodies of all animals, the same spiritual substance may compose their minds: Their consciousness; or that system of thought which they formed during life, may be continually dissolved by death, and nothing interests them in the new modification. The most positive assertors of the mortality of the soul never denied the immortality of its substance; and that an immaterial substance, as well as a material, may lose its memory or consciousness, appears in part from experience, if the soul be immaterial. Reasoning from the common course of nature, and without supposing any new interposition of the Supreme Cause, which ought always to be excluded from philosophy, *what is incorruptible must also be ingenerable* . The soul, therefore, if immortal, existed before our birth, and if the former existence noways concerned us, neither will the latter. Animals undoubtedly feel, think, love, hate, will, and even reason, though in a more imperfect

manner than men: Are their souls also immaterial and immortal?"[7]

Hume next proceeds to consider the moral arguments, and chiefly

". . . those derived from the justice of God, which is supposed to be further interested in the future punishment of the vicious and reward of the virtuous."

But if by the justice of God we mean the same attribute which we call justice in ourselves, then why should either reward or punishment be [204] extended beyond this life?[8] Our sole means of knowing anything is the reasoning faculty which God has given us; and that reasoning faculty not only denies us any conception of a future state, but fails to furnish a single valid argument in favour of the belief that the mind will endure after the dissolution of the body.

". . . If any purpose of nature be clear, we may affirm that the whole scope and intention of man's creation, so far as we can judge by natural reason, is limited to the present life."

To the argument that the powers of man are so much greater than the needs of this life require, that they suggest a future scene in which they can be employed, Hume replies:–

"If the reason of man gives him great superiority above other animals, his necessities are proportionably multiplied upon him; his whole time, his whole capacity, activity, courage, and passion, find sufficient employment in fencing against the miseries of his present condition; and frequently, nay, almost always, are too slender for the business assigned them. A pair of shoes, perhaps, was never yet wrought to the highest degree of perfection that commodity is capable of attaining; yet it is necessary, at least very useful, that there should be some politicians and moralists, even some geometers, poets and philosophers, among [205] mankind. The powers of men are no more superior to their wants, considered merely in this life, than those of foxes and hares are, compared to their wants and to their period of existence. The inference from parity of reason is therefore obvious."

In short, Hume argues that, if the faculties with which we are endowed are unable to discover a future state, and if the most attentive consideration of their nature serves to show that they are adapted to this life and nothing more, it is surely inconsistent with any conception of justice that we should be dealt with as if we had, all along, had a clear knowledge of the fact thus carefully concealed from us. What should we think of the justice of a father, who gave his son every reason to suppose that a trivial fault would only be visited by a box on the ear; and then, years afterwards, put him on the rack for a week for the same fault?

Again, the suggestion arises, if God is the cause of all things, he is responsible for evil as well as for good; and it appears utterly irreconcilable with our notions of justice that he should punish another for that which he has, in fact, done himself. Moreover, just punishment bears a proportion to the offence, while suffering which is infinite is *ipso facto* disproportionate to any finite deed.

"Why then eternal punishment for the temporary offences of so frail a creature as man? Can any one approve of

Alex[206]ander's rage, who intended to exterminate a whole nation because they had seized his favourite horse Buchephalus?

"Heaven and hell suppose two distinct species of men, the good and the bad; but the greatest part of mankind float betwixt vice and virtue. Were one to go round the world with the intention of giving a good supper to the righteous and a sound drubbing to the wicked, he would frequently be embarrassed in his choice, and would find the merits and demerits of most men and women scarcely amount to the value of either."[9]

One can but admire the broad humanity and the insight into the springs of action manifest in this passage. *Comprendre est à moitié pardonner.* The more one knows of the real conditions which determine men's acts the less one finds either to praise or blame. For kindly David Hume, "the damnation of one man is an infinitely greater evil in the universe than the subversion of a thousand million of kingdoms." And he would have felt with his countryman Burns, that even "auld Nickie Ben" should "hae a chance."

As against those who reason for the necessity of a future state, in order that the justice of the Deity may be satisfied, Hume's argumentation appears unanswerable. For if the justice of God [207] resembles what we mean by justice, the bestowal of infinite happiness for finite well-doing and infinite misery for finite ill-doing, it is in no sense just. And, if the justice of God does not resemble what we mean by justice, it is an abuse of language to employ the name of justice for the attribute described by it. But, as against those who choose to argue that there is nothing in what is known to us of the attributes of the Deity inconsistent with a future state of rewards and punishments, Hume's pleadings have no force. Bishop Butler's argument that, inasmuch as the visitation of our acts by rewards and punishments takes place in this life, rewards and punishments must be consistent with the attributes of the Deity, and therefore may go on as long as the mind endures, is unanswerable. Whatever exists is, by the hypothesis, existent by the will of God; and, therefore, the pains and pleasures which exist now may go on existing for all eternity, either increasing, diminishing, or being endlessly varied in their intensity, as they are now.

It is remarkable that Hume does not refer to the sentimental arguments for the immortality of the soul which are so much in vogue at the present day; and which are based upon our desire for a longer conscious existence than that which nature appears to have allotted to us. Perhaps he did not think them worth notice. For indeed it is not a little strange, that our strong desire [208] that a certain occurrence should happen should be put forward as evidence that it will happen. If my intense desire to see the friend, from whom I have parted, does not bring him from the other side of the world, or take me thither; if the mother's agonised prayer that her child should live has not prevented him from dying; experience certainly affords no presumption that the strong desire to be alive after death, which we call the aspiration after immortality, is any more likely to be gratified. As Hume truly says, "All doctrines are to be suspected which are favoured by our passions;" and the doctrine, that we are immortal because we should extremely like to be so, contains the quintessence of suspiciousness.

In respect of the existence and attributes of the soul, as of those of the Deity, then, logic is powerless and

reason silent. At the most we can get no further than the conclusion of Kant:–

"After we have satisfied ourselves of the vanity of all the ambitious attempts of reason to fly beyond the bounds of experience, enough remains of practical value to content us. It is true that no one may boast that he *knows* that God and a future life exist; for, if he possesses such knowledge, he is just the man for whom I have long been seeking. All knowledge (touching an object of mere reason) can be communicated, and therefore I might hope to see my own knowledge increased to this prodigious extent, by his instruction. No; our conviction in these matters is not *logical*, but *moral* certainty; and, inasmuch as it rests upon subjective grounds, (of moral disposition) [209] I must not even say: *it is* morally certain that there is a God, and so on; but, *I am* morally certain, and so on. That is to say: the belief in a God and in another world is so interwoven with my moral nature, that the former can no more vanish, than the latter can ever be torn from me.

"The only point to be remarked here is that this act of faith of the intellect (*Vernunftglaube*) assumes the existence of moral dispositions. If we leave them aside, and suppose a mind quite indifferent to moral laws, the inquiry started by reason becomes merely a subject for speculation; and [the conclusion attained] may then indeed be supported by strong arguments from analogy, but not by such as are competent to overcome persistent scepticism.

"There is no one, however, who can fail to be interested in these questions. For, although he may be excluded from moral influences by the want of a good disposition, yet, even in this case, enough remains to lead him to fear a divine existence and a future state. To this end, no more is necessary than that he can at least have no certainty that there is no such being, and no future life; for, to make this conclusion demonstratively certain, he must be able to prove the impossibility of both; and this assuredly no rational man can undertake to do. This negative belief, indeed, cannot produce either morality or good dispositions, but can operate in an analogous fashion, by powerfully repressing the outbreak of evil tendencies.

"But it will be said, is this all that Pure Reason can de when it gazes out beyond the bounds of experience? Nothing more than two articles of faith? Common sense could achieve as much without calling the philosophers to its counsels!

"I will not here speak of the service which philosophy has rendered to human reason by the laborious efforts of its criticism, granting that the outcome proves to be merely negative: about that matter something is to be said in the following section. But do you then ask, that the knowledge which interests all men shall transcend the common understanding and be discovered for you only by philosophers? The very thing which you make a reproach, is the best confirmation of the justice of the previous conclusions, since it shows that which [210] could not, at first, have been anticipated; namely, that in those matters which concern all men alike, nature is not guilty of distributing her gifts with partiality; and that the highest philosophy, in dealing with the most important concerns of humanity, is able to take us no further than the guidance which she affords to the commonest understanding."[10]

In short, nothing can be proved or disproved respecting either the distinct existence, the substance, or the durability of the soul. So far, Kant is at one with Hume. But Kant adds, as you cannot disprove the immortality of the soul, and as the belief therein is very useful for moral purposes, you may assume it. To which, had Hume lived half a century later, he would probably have replied, that, if morality has no better foundation than an assumption, it is not likely to bear much strain; and, if it has a better

foundation, the assumption rather weakens than strengthens it.

As has been already said, Hume is not content with denying that we know anything about the existence or the nature of the soul; but he carries the war into the enemy's camp, and accuses those who affirm the immateriality, simplicity, and indivisibility of the thinking substance of atheism and Spinozism, which are assumed to be convertible terms.

The method of attack is ingenious. Observation appears to acquaint us with two different systems of beings, and both Spinoza and orthodox [211] philosophers agree, that the necessary substratum of each of these is a substance, in which the phenomena adhere, or of which they are attributes or modes.

"I observe first the universe of objects or of body; the sun, moon, and stars; the earth, seas, plants, animals, men, ships, houses, and other productions either of art or of nature. Here Spinoza appears, and tells me that these are only modifications and that the subject in which they inhere is simple, uncompounded, and indivisible. After this I consider the other system of beings, viz. the universe of thought, or my impressions and ideas. Then I observe another sun, moon, and stars an earth and seas, covered and inhabited by plants and animals, towns, houses, mountains, rivers; and, in short, everything I can discover or conceive in the first system. Upon my inquiring concerning these, theologians present themselves, and tell me that these also are modifications, and modifications of one simple, uncompounded, and indivisible substance. Immediately upon which I am deafened with the noise of a hundred voices, that treat the first hypothesis with detestation and scorn, and the second with applause and veneration. I turn my attention to these hypotheses to see what may be the reason of so great a partiality and find that they have the same fault of being unintelligible, and that, as far as we can understand them, they are so much alike, that 'tis impossible to discover any absurdity in one, which is not common to both of them."–(I. p. 309.)

For the manner in which Hume makes his case good, I must refer to the original. Plain people may rest satisfied that both hypotheses are unintelligible, without plunging any further among syllogisms, the premisses of which convey no meaning, while the conclusions carry no conviction.

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[1] "Our internal intuition shows no permanent existence, for the Ego is only the consciousness of my thinking." "There is no means whatever by which we can learn anything respecting the constitution of the soul, so far as regards the possibility of its separate existence. "–*Kritik von den Paralogismen der reisen Vernunft.*

[2] *Essays on Some of the Peculiarities of the Christian Religion,* (Essay I. Revelation of a Future State), by Richard Whately, D.D., Archbishop of Dublin. Fifth Edition, revised, 1846.

[3] *The Future States: their Evidences and Nature; considered on Principles Physical, Moral, and Scriptural, with the Design of showing the Value of the Gospel Revelation,* by the Right Rev. Reginald Courtenay, D.D., Lord Bishop of Kingston (Jamaica), 1857.

[4] "Now that 'Jesus Christ brought life and immortality to light through the Gospel,' and that in the most literal sense which implies that the revelation of the doctrine is *peculiar* to His Gospel, seems to be at least the most

obvious meaning of the Scriptures of the New Testament."–Whately, *l.c.* p. 27.

[5] Compare *Of the Immateriality of the Soul,* Section V. of Part IV., Book I., of the *Treatise,* in which Hume concludes (I. p. 319) that, whether it be material or immaterial, "in both cases the metaphysical arguments for the immortality of the soul are equally inconclusive- and in both cases the moral arguments and those derived from the analogy of nature are equally strong and convincing."

[6] "The question again respecting the materiality of the soul is one which I am at a loss to understand clearly, till it shall hare been clearly determined *what matter is.* We know nothing of it, any more than of mind, except its attributes."–Whately, *l.c.* p. 667

[7] "None of those who contend for the natural immortality of the soul . . . have been able to extricate themselves from one difficulty, viz. that all their arguments apply, with exactly the same force, to prove an immortality, not only of *brutes,* but even of *plants;* though in such a conclusion as this they are never willing to acquiesce. "–Whately, *l.c.* p. 67.

[8] "Nor are we therefore authorised to infer *a priori,* independent of Revelation, a future state of retribution, from the irregularities prevailing in the present life, since that future state does not account fully for these irregularities. It may explain, indeed, how present evil may be conducive to future good, but not why the good could not be attained without the evil: it may reconcile with our notions of the divine justice the present prosperity of the wicked, but it does not account for the existence of the wicked. "–Whately, *l.c.* pp. 69, 70.

[9] "So reason also shows, that for man to expect to earn for himself by the practice of virtue, and claim, as his just right an immortality of exalted happiness, is a most extravagant and groundless pretension."–Whately, *l.c.* 101. On the other hand, however, the Archbishop sees no unreasonableness in a man's earning for himself an immortality of intense unhappiness by the practice of vice. So that life is, naturally, a venture in which you may lose all, but can earn nothing. It may be thought somewhat hard upon mankind if they are pushed into a speculation of this sort, willy-nilly.

[10] *Kritik der reinen Vernunft.* Ed. Hartenstein, p. 547.

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[212] Chapter X

Volition: Liberty and Necessity

In the opening paragraphs of the third part of the second book of the "Treatise," Hume gives a description of the will.

"Of all the immediate effects of pain and pleasure there is none more remarkable than the *will;* and though, properly speaking, it be not comprehended among the passions, yet as the full understanding of its nature and properties is necessary to the explanation of them, we shall here make it the subject of our inquiry. I desire it may be observed, that, by the *will,* I mean nothing but *the internal impression we feel, and are conscious of, when we*

knowingly give rise to any new motion of our body, or new perception of our mind. This impression, like the preceding ones of pride and humility, love and hatred, 'tis impossible to define, and needless to describe any further. "–(II. p. 150.)

This description of volition may be criticised on various grounds. More especially does it seem defective in restricting the term "will" to that feeling which arises when we act, or appear to act, as causes: for one may will to strike, with[213]out striking; or to think of something which we have forgotten.

Every volition is a complex idea composed of two elements: the one is the idea of an action; the other is a desire for the occurrence of that action. If I will to strike, I have an idea of a certain movement, and a desire that that movement should take place; if I will to think of any subject, or, in other words, to attend to that subject, I have an idea of the subject and a strong desire that it should remain present to my consciousness. And so far as I can discover, this combination of an idea of an object with an emotion, is everything that can be directly observed in an act of volition. So that Hume's definition may be amended thus: Volition is the impression which arises when the idea of a bodily or mental action is accompanied by the desire that the action should be accomplished. It differs from other desires simply in the fact, that we regard ourselves as possible causes of the action desired.

Two questions arise, in connexion with the observation of the phenomenon of volition, as they arise out of the contemplation of all other natural phenomena. Firstly, has it a cause; and, if so, what is its cause? Secondly, is it followed by any effect, and if so, what effect does it produce?

Hume points out, that the nature of the phe[214]nomena we consider can have nothing to do with the origin of the conception that they are connected by the relation of cause and effect. For that relation is nothing but an order of succession, which, so far as our experience goes, is invariable; and it is obvious that the nature of phenomena has nothing to do with their order. Whatever it is that leads us to seek for a cause for every event, in the case of the phenomena of the external world, compels us, with equal cogency, to seek it in that of the mind.

The only meaning of the law of causation, in the physical world, is, that it generalises universal experience of the order of that world; and, if experience shows a similar order to obtain among states of consciousness, the law of causation will properly express that order.

That such an order exists, however, is acknowledged by every sane man:

"Our idea, therefore, of necessity and causation, arises entirely from the uniformity observable in the operations of nature, where similar objects are constantly conjoined together, and the mind is determined by custom to infer the one from the appearance of the other. These two circumstances form the whole of that necessity which we ascribe to matter. Beyond the constant *conjunction* of similar objects and the consequent *inference* from one to the other, we have no notion of any necessity of connexion.

"If it appear, therefore, what all mankind have ever allowed, without any doubt or hesitation, that these two circumstances take place in the voluntary actions of men, and in the operations of mind, it must follow that all

mankind [215] have ever agreed in the doctrine of necessity, and that they have hitherto disputed merely from not understanding each other."–(IV. p.97)

But is this constant conjunction observable in human actions? A student of history could give but one answer to this question:

"Ambition, avarice, self-love, vanity, friendship, generosity, public spirit: these passions, mixed in various degrees, and distributed through society, have been, from the beginning of the world and still are, the source of all the actions and enterprizes which have ever been observed among mankind. Would you know the sentiments, inclinations, and course of life of the Greeks and Romans? Study well the temper and actions of the French and English. You cannot be much mistaken in transferring to the former most of the observations which you have made with regard to the latter. Mankind are so much the same, in all times and places, that history informs us of nothing new or strange in this particular. Its chief use is only to discover the constant and universal principles of human nature, by showing men in all varieties of circumstances and situations, and furnishing us with materials from which we may form our observations, and become acquainted with the regular springs of human action and behaviour. These records of wars, intrigues, factions, and revolutions are so many collections of experiments, by which the politician or moral philosopher fixes the principles of his science, in the same manner as the physician or natural philosopher becomes acquainted with the nature of plants, minerals, and other external objects, by the experiments which he forms concerning them. Nor are the earth, air, water, and other elements examined by Aristotle and Hippocrates more like to those which at present lie under our observation, than the men described by Polybius and Tacitus are to those who now govern the world."–(IV. pp. 97-8.)

Hume proceeds to point out that the value set upon experience in the conduct of affairs, whether [216] of business or of politics, involves the acknowledgment that we base our expectation of what men will do, upon our observation of what they have done; and, that we are as firmly convinced of the fixed order of thoughts as we are of that of things. And, if it be urged that human actions not unfrequently appear unaccountable and capricious, his reply is prompt:–

"I grant it possible to find some actions which seem to have no regular connexion with any known motives, and are exceptions to all the measures of conduct which have ever been established for the government of men. But if one could willingly know what judgment should be formed of such irregular and extraordinary actions, we may consider the sentiments commonly entertained with regard to those irregular events which appear in the course of nature, and the operations of external objects. All courses are not conjoined to their usual effects with like uniformity. An artificer, who handles only dead matter, may be disappointed in his aim, as well as the politician who directs the conduct of sensible and intelligent agents.

"The vulgar, who take things according to their first appearance, attribute the uncertainty of events to such an uncertainty in the causes as make the latter often fail of their usual influence, though they meet with no impediment to their operation. But philosophers, observing that, almost in every part of nature, there is contained a vast variety of springs and principles, which are hid, by reason of their minuteness or remoteness, find that it is at least possible the contrariety of events may not proceed from any contingency in the cause, but from the secret operation of contrary causes. This possibility is converted into certainty by further observation, when they remark that, upon an exact scrutiny, a contrariety of effects always betrays a contrariety of causes, and proceeds from their mutual opposition. A peasant can give no better reason for [217] the stopping of any clock or watch, than to say that it does not commonly go right. But an artist easily perceives that the same force in the spring or

pendulum has always the same influence on the wheels; but fails of its usual effect, perhaps by reason of a grain of dust, which puts a stop to the whole movement. From the observation of several parallel instances, philosophers form a maxim, that the connexion between all causes and effects is equally necessary, and that its seeming uncertainty in some instances proceeds from the secret opposition of contrary causes."–(IV. pp. 101-2.)

So with regard to human actions:–

"The internal principles and motives may operate in a uniform manner, notwithstanding these seeming irregularities; in the same manner as the winds, rains, clouds, and other variations of the weather are supposed to be governed by steady principles; though not easily discoverable by human sagacity and inquiry."–(IV. p. 103.)

Meteorology, as a science, was not in existence in Hume's time, or he would have left out the "supposed to be." In practice, again, what difference does any one make between natural and moral evidence?

"A prisoner who has neither money nor interest, discovers the impossibility of his escape, as well, when he considers the obstinacy of the goaler, as the walls and bars with which he is surrounded; and, in all attempts for his freedom, chooses rather to work upon the stone and iron of the one, than upon the inflexible nature of the other. The same prisoner, when conducted to the scaffold, foresees his death as certainly from the constancy and fidelity of his guards, as from the operation of the axe or wheel. His mind runs along a certain train of ideas: The refusal of the soldiers to consent to his escape: the action of the executioner; the separation of the head and body; [218] bleeding, convulsive motions, and death. Here is a connected chain of natural causes and voluntary actions; but the mind feels no difference between them, in passing from one link to another, nor is less certain of the future event, than if it were connected with the objects presented to the memory or senses, by a train of causes cemented together by what we are pleased to call a *physical* necessity. The same experienced union has the same effect on the mind, whether the united objects be motives, volition, and actions; or figure and motion. We may change the names of things but their nature and their operation on the understanding never change."–(IV. pp. 105-6.)

But, if the necessary connexion of our acts with our ideas has always been acknowledged in practice, why the proclivity of mankind to deny it words?

"If we examine the operations of body, and the production of effects from their causes, we shall find that all our faculties can never carry us further in our knowledge of this relation, than barely to observe, that particular objects are *constantly conjoined* together, and that the mind is carried, by a *customary transition*, from the appearance of the one to the belief of the other. But though this conclusion concerning human ignorance be the result of the strictest scrutiny of this subject, men still entertain a strong propensity to believe, that they penetrate further into the province of nature, and perceive something like a necessary connexion between cause and effect. When, again, they turn their reflections towards the operations of their own minds, and *feel* no such connexion between the motive and the action; they are thence apt to suppose, that there is a difference between the effects which result from material force, and those which arise from thought and intelligence. But, being once convinced, that we know nothing of causation of any kind, than merely the *constant conjunction* of objects, and the consequent *inference* of the mind from one to another, and finding that these two circumstances are universally allowed to have [219] place in voluntary actions; we may be more easily led to own the same necessity common to all causes."–(IV. pp. 107, 8)

The last asylum of the hard-pressed advocate of the doctrine of uncaused volition is usually, that, argue as you like, he has a profound and ineradicable consciousness of what he calls the freedom of his will. But Hume follows him even here, though only in a note, as if he thought the extinction of so transparent a sophism hardly worthy of the dignity of his text.

"The prevalence of the doctrine of liberty may be accounted for from another cause, viz. a false sensation, or seeming experience, which we have, or may have, of liberty or indifference in many of our actions. The necessity of any action, whether of matter, or of mind, is not, properly speaking, a quality in the agent, but in any thinking or intelligent being who may consider the action; and it consists chiefly in the determination of his thoughts to infer the existence of that action from some preceding objects; as liberty, when opposed to necessity, is nothing but the want of that determination, and a certain looseness or indifference which we feel in passing, or not passing, from the idea of any object to the idea of any succeeding one. Now we may observe that though, in *reflecting* on human actions, we seldom feel such looseness or indifference, but are commonly able to infer them with considerable certainty from their motives, and from the dispositions of the agent; yet it frequently happens that in *performing* the actions themselves, we are sensible of something like it: And as all resembling objects are taken for each other, this has been employed as demonstrative and even intuitive proof of human liberty. We feel that our actions are subject to our will on most occasions; and imagine we feel that the will itself is subject to nothing, because, when by a denial of it we are provoked to try, we feel that it moves easily every way, and produces an image of itself [220] (or a *Velleity* as it is called in the schools), even on that side on which it did not settle. This image or faint notion, we persuade ourselves, could at that time have been completed into the thing itself; because, should that be denied, we find upon a second trial that at present it can. We consider not that the fantastical desire of showing liberty is here the motive of our actions."–(IV. p. 110, *note.*)

Moreover the moment the attempt is made to give a definite meaning to the words, the supposed opposition between free will and necessity turns out to be a mere verbal dispute.

"For what is meant by liberty, when applied to voluntary actions? We cannot surely mean, that actions have so little connexion with motive, inclinations, and circumstances, that one does not follow with a certain degree of uniformity from the other, and that one affords no inference by which we can conclude the existence of the other. For these are plain and acknowledged matters of fact. By liberty, then, we can only mean *a power of acting or not acting according to the determinations of the will;* that is, if we choose to remain at rest, we may; if we choose to move, we also may. Now this hypothetical liberty is universally allowed to belong to every one who is not a prisoner and in chains. Here then is no subject of dispute."–(IV. p. 111.)

Half the controversies about the freedom of the will would have had no existence, if this pithy paragraph had been well pondered by those who oppose the doctrine of necessity. For they rest upon the absurd presumption that the proposition, "I can do as I like," is contradictory to the doctrine of necessity. The answer is; nobody doubts that, at any rate within certain limits, you can do as [221] you like. But what determines your likings and dislikings? Did you make your own constitution? Is it your contrivance that one thing is pleasant and another is painful? And even if it were, why did you prefer to make it after the one fashion rather than the other? The passionate assertion of the consciousness of their freedom, which is the favourite refuge of the opponents of the doctrine of necessity, is mere futility, for nobody denies it. What they really have to do, if they would upset the necessarian argument, is to prove that they are free to associate any emotion whatever with any idea whatever; to like pain as much as pleasure; vice as

much as virtue; in short, to prove, that, whatever may be the fixity of order of the universe of things, that of thought is given over to chance.

In the second part of this remarkable essay, Hume considers the real, or supposed, immoral consequences of the doctrine of necessity, premising the weighty observation that

"When any opinion leads to absurdity, it is certainly false; but it is not certain that an opinion is false because it is of dangerous consequence."–(IV. p. 112)

And, therefore, that the attempt to refute an opinion by a picture of its dangerous consequences to religion and morality, is as illogical as it is reprehensible.

It is said, in the first place, that necessity de[222]stroys responsibility; that, as it is usually put, we have no right to praise or blame actions that cannot be helped. Hume's reply amounts to this, that the very idea of responsibility implies the belief in the necessary connexion of certain actions with certain states of the mind. A person is held responsible only for those acts which are preceded by a certain intention; and, as we cannot see, or hear, or feel, an intention, we can only reason out its existence on the principle that like effects have like causes.

If a man is found by the police busy with "jemmy" and dark lantern at a jeweller's shop door over night, the magistrate before whom he is brought the next morning, reasons from those effects to their causes in the fellow's burglarious ideas and volitions, with perfect confidence, and punishes him accordingly. And it is quite clear that such a proceeding would be grossly unjust, if the links of the logical process were other than necessarily connected together. The advocate who should attempt to get the man off on the plea that his client need not necessarily have had a felonious intent, would hardly waste his time more, if he tried to prove that the sum of all the angles of a triangle is not two right angles, but three.

A man's moral responsibility for his acts has, in fact, nothing to do with the causation of these acts, but depends on the frame of mind which [223] accompanies them. Common language tells us this, when it uses "well disposed" as the equivalent of "good," and "evil-minded" as that of "wicked." If A does something which puts B in a violent passion, it is quite possible to admit that B's passion is the necessary consequence of A's act, and yet to believe that B's fury is morally wrong, or that be ought to control it. In fact, a calm bystander would reason with both on the assumption of moral necessity. He would say to A, "You were wrong in doing a thing which you knew (that is, of the necessity of which you were convinced) would irritate B." And he would say to B, "You are wrong to give way to passion, for you know its evil effects "–that is the necessary connection between yielding to passion and evil.

So far, therefore, from necessity destroying moral responsibility, it is the foundation of all praise and blame; and moral admiration reaches its climax in the ascription of necessary goodness to the Deity.

To the statement of another consequence of the necessarian doctrine, that, if there be a God, he must be the cause of all evil as well as of all good, Hume gives no real reply–probably because none is possible.

But then, if this conclusion is distinctly and unquestionably deducible from the doctrine of necessity, it is no less unquestionably a direct consequence of every known form of monotheism. If God is the cause of all things, [224] he must be the cause of evil among the rest; if he is omniscient, he must have the fore-knowledge of evil; if he is almighty, he must possess the power of preventing, or of extinguishing evil. And to say that an all-knowing and all-powerful being is not responsible for what happens, because he only permits it, is, under its intellectual aspect, a piece of childish sophistry; while, as to the moral look of it, one has only to ask any decently honourable man, whether, under like circumstances, he would try to get rid of his responsibility by such a plea.

Hume's "Inquiry" appeared in 1748. He does not refer to Anthony Collins' essay on Liberty, published thirty-three years before, in which the same question is treated to the same effect, with singular force and lucidity. It may be said, perhaps, that it is not wonderful that the two freethinkers should follow the same line of reasoning; but no such theory will account for the fact that in 1754, the famous Calvinistic divine, Jonathan Edwards, President of the College of New Jersey, produced, in the interests of the straitest orthodoxy, a demonstration of the necessarian thesis, which has never been equalled in power, and certainly has never been refuted.

In the ninth section of the fourth part of Edwards's "Inquiry," he has to deal with the Arminian objection to the Calvinistic doctrine that "it makes God the author of sin"; and it is [225] curious to watch the struggle between the theological controversialist, striving to ward off an admission which he knows will be employed to damage his side, and the acute logician, conscious that, in some shape or other, the admission must be made. Beginning with a *tu quoque* that the Arminian doctrine involves consequences as bad as the Calvinistic view, he proceeds to object to the term "author of sin," though he ends by admitting that, in a certain sense, it is applicable; he proves from Scripture, that God is the disposer and orderer of sin; and then, by an elaborate false analogy with the darkness resulting from the absence of the sun, endeavours to suggest that he is only the author of it in a negative sense; and, finally, he takes refuge in the conclusion that, though God is the orderer and disposer of those deeds which, considered in relation to their agents, are morally evil, yet inasmuch as His purpose has all along been infinitely good, they are not evil relatively to Him.

And this, of course, may be perfectly true; but if true, it is inconsistent with the attribute of Omnipotence. It is conceivable that there should be no evil in the world; that which is conceivable is certainly possible; if it were possible for evil to be non-existent, the maker of the world, who, though foreknowing the existence of evil in that world, did not prevent it, either did not really desire it should not exist, or could not prevent its [226] existence. It might be well for those who inveigh against the logical consequences of necessarianism to bethink them of the logical consequences of theism; which are not only the same, when the attribute of Omniscience is ascribed to the Deity, but which bring out, from the existence of moral evil, a hopeless conflict between the attributes of Infinite Benevolence and Infinite Power, which, with no less assurance, are affirmed to appertain to the Divine Being.

Kant's mode of dealing with the doctrine of necessity is very singular. That the phenomena of the mind follow fixed relations of cause and effect is, to him, as unquestionable as it is to Hume. But then there is the *ding an sich*, the *Noumenon*, or Kantian equivalent for the substance of the soul. This, being out of

the phenomenal world, is subject to none of the laws of phenomena, and is consequently as absolutely free, and as completely powerless, as a mathematical point, *in vacuo*, would be. Hence volition is uncaused, so far as it belongs to the noumenon; but, necessary, so far as it takes effect in the phenomenal world.

Since Kant is never weary of telling us that we know nothing whatever, and can know nothing, about the noumenon, except as the hypothetical subject of any number of negative predicates; the information that it is free, in the sense of being out of reach of the law of causation, is about as [227] valuable as the assertion that it is neither gray, nor blue, nor square. For practical purposes, it must be admitted that the inward possession of such a noumenal libertine does not amount to much for people whose actual existence is made up of nothing but definitely regulated phenomena. When the good and evil angels fought for the dead body of Moses, its presence must have been of about the same value to either of the contending parties, as that of Kant's noumenon, in the battle of impulses which rages in the breast of man. Metaphysicians, as a rule, are sadly deficient in the sense of humour; or they would surely abstain from advancing propositions which, when stripped of the verbiage in which they are disguised, appear to the profane eye to be bare shams, naked but not ashamed.

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[228] Chapter XI

The Principles of Morals

"In the same year [1752] was published at London my 'Inquiry Concerning the Principles of Morals'; which in my own opinion (who ought not to judge on that subject) is of all my writings, historical, philosophical, and literary, incomparably the best. It came unnoticed and unobserved into the world."

It may commonly be noticed that the relative value which an author ascribes to his own works rarely agrees with the estimate formed of them by his readers; who criticise the products, without either the power, or the wish, to take into account the pains which they may have cost the producer. Moreover, the clear and dispassionate common sense of the "Inquiry Concerning the Principles of Morals" may have tasted flat after the highly-seasoned "Inquiry Concerning the Human Understanding." Whether the public like to be deceived, or not, may be open to question; but it is beyond a doubt that they love to [229] be shocked in a pleasant and mannerly way. Now Hume's speculations on moral questions are not so remote from those of respectable professors, like Hutcheson, or saintly prelates, such as Butler, as to present any striking novelty. And they support the cause of righteousness in a cool, reasonable, indeed slightly patronising fashion, eminently in harmony with the mind of the eighteenth century; which admired virtue very much, if she would only avoid the rigour which the age called fanaticism, and the fervour which it called enthusiasm.

Having applied the ordinary methods of scientific inquiry to the intellectual phenomena of the mind, it was natural that Hume should extend the same mode of investigation to its moral phenomena; and, in the true spirit of a natural philosopher, he commences by selecting a group of those states of consciousness

with which every one's personal experience must have made him familiar: in the expectation that the discovery of the sources of moral approbation and disapprobation, in this comparatively easy case, may furnish the means of detecting them when they are more recondite.

"We shall analyse that complication of mental qualities which form what, in common life, we call personal merit: We shall consider every attribute of the mind, which renders a man an object either of esteem and affection, or of hatred and contempt; every habit or sentiment or faculty, which if ascribed to any person, implies either praise or blame, and may enter into any panegyric or satire of his character and manners. The quick sensibility, which, on this head, is so universal among [230] mankind, gives a philosopher sufficient assurance that he can never be considerably mistaken in framing the catalogue, or incurs any danger of misplacing the objects of his contemplation: He needs only enter into his own breast for a moment, and consider whether he should or should not desire to have this or that quality assigned to him, and whether such or such an imputation would proceed from a friend or an enemy. The very nature of language guides us almost infallibly in forming a judgment of this nature; and as every tongue possesses one set of words which are taken in a good sense, and another in the opposite, the least acquaintance with the idiom suffices, without any reasoning, to direct us in collecting and arranging the estimable or blamable qualities of men. The only object of reasoning is to discover the circumstances on both sides, which are common to these qualities; to observe that particular in which the estimable qualities agree on the one hand, and the blamable on the other, and thence to reach the foundation of ethics, and find their universal principles, from which all censure or approbation is ultimately derived. As this is a question of fact, not of abstract science, we can only expect success by following the experimental method, and deducing general maxims from a comparison of particular instances. The other scientifical method, where a general abstract principle is first established, and is afterwards branched out into a variety of inferences and conclusions, may be more perfect in itself, but suits less the imperfection of human nature, and is a common source of illusion and mistake, in this as well as in other subjects. Men are now cured of their passion for hypotheses and systems in natural philosophy, and will hearken to no arguments but those which are derived from experience. It is full time they should attempt a like reformation in all moral disquisitions; and reject every system of ethics, however subtile or ingenious, which is not founded on fact and observation."–(IV. pp. 242–4.)

No qualities give a man a greater claim to personal merit than benevolence and justice; but if we inquire why benevolence deserves so much [231] praise, the answer will certainly contain a large reference to the utility of that virtue to society; and as for justice, the very existence of the virtue implies that of society; public utility is its sole origin; and the measure of its usefulness is also the standard of its merit. If every man possessed everything he wanted, and no one had the power to interfere with such possession; or if no man desired that which could damage his fellow-man, justice would have no part to play in the universe. But as Hume observes:–

"In the present disposition of the human heart, it would perhaps be difficult to find complete instances of such enlarged affections; but still we may observe that the case of families approaches towards it; and the stronger the mutual benevolence is among the individuals, the nearer it approaches, till all distinction of property be in a great measure lost and confounded among them. Between married persons, the cement of friendship is by the laws supposed so strong, as to abolish all division of possessions, and has often, in reality, the force assigned to it.[1] And it is observable that, during the ardour of new enthusiasms, when every principle is inflamed into extravagance, the community of goods has frequently been attempted; and nothing but experience of its inconveniences, from the returning or disguised selfishness of men, could make the imprudent fanatics adopt anew the ideas of justice and separate property. So true is it that this virtue derives its existence entirely from its

necessary *use* to the intercourse and social state of mankind." [1] (IV. p. 256.)

"Were the human species so framed by nature as that each [232] individual possessed within himself every faculty requisite both for his own preservation and for the propagation of his kind: Were all society and intercourse cut off between man and man by the primary intention of the Supreme Creator: It seems evident that so solitary a being would be as much incapable of justice as of social discourse and conversation. Where mutual regard and forbearance serve to no manner of purpose, they would never direct the conduct of any reasonable man. The headlong course of the passions would be checked by no reflection on future consequences. And as each man is here supposed to love himself alone, and to depend only on himself and his own activity for safety and happiness, he would, on every occasion, to the utmost of his power, challenge the preference above every other being, to none of which he is bound by any ties, either of nature or of interest.

"But suppose the conjunction of the sexes to be established in nature, a family immediately arises; and particular rules being found requisite for its subsistence, these are immediately embraced, though without comprehending the rest of mankind within their prescriptions. Suppose that several families unite together in one society, which is totally disjoined from all others, the rules which preserve peace and order enlarge themselves to the utmost extent of that society; but becoming then entirely useless, lose their force when carried one step further. But again, suppose that several distinct societies maintain a kind of intercourse for mutual convenience and advantage, the boundaries of justice still grow larger, in proportion to the largeness of men's views and the force of their mutual connexion. History, experience, reason, sufficiently instruct us in this natural progress of human sentiments, and in the gradual enlargement of our regard to justice in proportion as we become acquainted with the extensive utility of that virtue." (IV. pp. 262–4.)

The moral obligation of justice and the rights of property are by no means diminished by this exposure of the purely utilitarian basis on which they rest.–

"For what stronger foundation can be desired or conceived [233] for any duty, than to observe that human society, or even human nature, could not subsist without the establishment of it, and will still arrive at greater degrees of happiness and perfection, the more invisible the regard is which is paid to that duty?

"The dilemma seems obvious: As justice evidently tends to promote public utility, and to support civil society, the sentiment of justice is either derived from our reflecting on that tendency, or, like hunger, thirst, and other appetites, resentment, love of life, attachment to offspring, and other passions, arises from a simple original instinct in the human heart, which nature has implanted for like salutary purposes. If the latter be the case it follows that property which is the object of justice, is also distinguished by a simple original instinct, and is not ascertained by any argument or reflection. But who is there that ever heard of such an instinct? Or is this a subject in which new discoveries can be made? We may as well expect to discover in the body new senses which had before escaped the observation of all mankind."–(IV. pp. 273–4.)

The restriction of the object of justice to property, in this passage, is singular. Pleasure and pain can hardly be included under the term property, and yet justice surely deals largely with the withholding of the former, or the infliction of the latter, by men on one another. If a man bars another from a pleasure which he would otherwise enjoy, or actively hurts him without good reason, the latter is said to be injured as much as if his property had been interfered with. Here, indeed, it may be readily shown, that it

is as much the interest of society that men should not interfere with one another's freedom, or mutually inflict positive or negative pain, as that they should not [234] meddle with one another's property; and hence the obligation of justice in such matters may be deduced. But, if a man merely thinks ill of another, or feels maliciously towards him without due cause, he is properly said to be unjust. In this case it would be hard to prove that any injury is done to society by the evil thought; but there is no question that it will be stigmatised as an injustice; and the offender himself, in another frame of mind, is often ready enough to admit that he has failed to be just towards his neighbour. However, it may plausibly be said, that so slight a barrier lies between thought and speech, that any moral quality attached to the latter is easily transferred to the former; and that, since open slander is obviously opposed to the interests of society, injustice of thought, which is silent slander, must become inextricably associated with the same blame.

But, granting the utility to society of all kinds of benevolence and justice, why should the quality of those virtues involve the sense of moral obligation?

Hume answers this question in the fifth section entitled, "Why Utility Pleases." He repudiates the deduction of moral approbation from self-love, and utterly denies that we approve of benevolent or just actions because we think of the benefits which they are likely to confer indirectly on ourselves. The source of the approbation with which we view an act useful to society must be sought [235] elsewhere; and, in fact, is to be found in that feeling which is called sympathy.

"No man is absolutely indifferent to the happiness and misery of others. The first has a natural tendency to give pleasure, the second pain. This every one may find in himself. It is not probable that these principles can be resolved into principles more simple and universal, whatever attempts may have been made for that purpose."–(IV. p. 294, *Note*.)

Other men's joys and sorrows are not spectacles at which we remain unmoved.–

". . . The view of the former, whether in its causes or effects, like sunshine, or the prospect of well-cultivated plains (to carry our pretensions no higher) communicates a secret joy and satisfaction; the appearance of the latter, like a lowering cloud or barren landscape, throws a melancholy damp over the imagination. and this concession being once made, the difficulty is over; and a natural unforced interpretation of the phenomena of human life will afterwards, we hope, prevail among all speculative inquirers."–(IV. p. 320.)

The moral approbation, therefore, with which we regard acts of justice or benevolence rests upon their utility to society, because the perception of that utility or, in other words, of the pleasure which they give to other men, arouses a feeling of sympathetic pleasure in ourselves. The feeling of obligation to be just, or of the duty of justice, arises out of that association of moral approbation or disapprobation with one's own actions, which is what we call conscience. To fail in justice, or in benevolence, is to be displeased with one's self. But happiness is impossible without inward self-[236]approval; and, hence, every man who has any regard to his own happiness and welfare, will find his best reward in the practice of every moral duty. On this topic Hume expends much eloquence.

"But what philosophical truths can be more advantageous to society than these here delivered, which represent virtue in all her genuine and most engaging charms, and make us approach her with ease, familiarity, and affection? The dismal dress falls off, with which many divines and some philosophers have covered her; and nothing appears but gentleness, humanity, beneficence, affability; nay, even at proper intervals, play, frolic, and gaiety. She talks not of useless austerities and rigours, suffering and self-denial. she declares that her sole purpose is to make her votaries, and all mankind during every period of their existence, if possible, cheerful and happy; nor does she ever willingly part with any pleasure but in hopes of ample compensation in some other period of their lives. The sole trouble which she demands is that of just calculation, and a steady preference of the greater happiness. And if any austere pretenders approach her, enemies to joy and pleasure, she either rejects them as hypocrites and deceivers, or if she admit them in her train they are ranked, however, among the least favoured of her votaries.

"And, indeed, to drop all figurative expression, what hopes can we ever have of engaging mankind to a practice which we confess full of austerity and rigour? Or what theory of morals can ever serve any useful purpose, unless it can show, by a particular detail, that all the duties which it recommends are also the true interest of each individual? The peculiar advantage of the foregoing system seems to be, that it furnishes proper mediums for that purpose."–(IV. p. 360.)

In this pæan to virtue, there is more of the dance measure than will sound appropriate in the [237] ears of most of the pilgrims who toil painfully, not without many a stumble and many a bruise, along the rough and steep roads which lead to the higher life.

Virtue is undoubtedly beneficent; but the man is to be envied to whom her ways seem in anywise playful. And though she may not talk much about suffering and self-denial, her silence on that topic may be accounted for on the principle *ça va sans dire*. The calculation of the greatest happiness is not performed quite so easily as a rule or three sum; while, in the hour of temptation, the question will crop up, whether, as something has to be sacrificed, a bird in the hand is not worth two in the bush; whether it may not be as well to give up the problematical greater happiness in the future, for a certain great happiness in the present, and

"Buy the merry madness of one hour
With the long irksomeness of following time."[2]

If mankind cannot be engaged in practices "full of austerity and rigour," by the love of righteousness and the fear of evil, without seeking for other compensation than that which flows from the gratification of such love and the consciousness of escape from debasement, they are in a bad case. For they will assuredly find that virtue presents no very close likeness to the sportive leader of the joyous hours in Hume's rosy picture; but that she [238] is an awful Goddess, whose ministers are the Furies, and whose highest reward is peace.

It is not improbable that Hume would have qualified all this as enthusiasm or fanaticism, or both; but he virtually admits it:–

"Now, as virtue is an end, and is desirable on its own account, without fee or reward, merely for the immediate satisfaction which it conveys, it is requisite that there should be some sentiment which it touches; some internal taste or feeling, or whatever you please to call it, which distinguishes moral good and evil, and which embraces the one and rejects the other.

"Thus the distinct boundaries and offices of *reason* and of *taste* are easily ascertained. The former conveys the knowledge of truth and falsehood: The latter gives the sentiment of beauty and deformity, vice and virtue. The one discovers objects as they really stand in nature, without addition or diminution: The other has a productive faculty, and gilding and staining all natural objects with the colours borrowed from internal sentiment, raises in a manner a new creation. Reason being cool and disengaged, is no motive to action, and directs only the impulse received from appetite or inclination, by showing us the means of attaining happiness or avoiding misery. Taste, as it gives pleasure or pain, and thereby constitutes happiness or misery, becomes a motive to action, and is the first spring or impulse to desire and volition. From circumstances and relations known or supposed, the former leads us to the discovery of the concealed and unknown. After all circumstances and relations are laid before us, the latter makes us feel from the whole a new sentiment of blame or approbation. The standard of the one, being founded on the nature of things, is external and inflexible, even by the will of the Supreme Being: The standard of the other, arising from the internal frame and constitution of animals, is ultimately derived from the Supreme Will, which bestowed on each being its peculiar nature, and arranged the several classes and orders of existence."–(IV. pp. 376–7.)

Hume has not discussed the theological theory [239] of the obligations of morality, but it is obviously in accordance with his view of the nature of those obligations. Under its theological aspect, morality is obedience to the will of God; and the ground for such obedience is two-fold: either we ought to obey God because He will punish us if we disobey Him, which is an argument based on the utility of obedience; or our obedience ought to flow from our love towards God, which is an argument based on pure feeling and for which no reason can be given. For, if any man should say that he takes no pleasure in the contemplation of the ideal of perfect holiness, or, in other words, that he does not love God, the attempt to argue him into acquiring that pleasure would be as hopeless as the endeavour to persuade Peter Bell of the "witchery of the soft blue sky."

In whichever way we look at the matter, morality is based on feeling, not on reason; though reason alone is competent to trace out the effects of our actions and thereby dictate conduct. Justice is founded on the love of one's neighbour; and goodness is a kind of beauty. The moral law, like the laws of physical nature, rests in the long run upon instinctive intuitions, and is neither more nor less "innate" and "necessary" than they are. Some people cannot by any means be got to understand the first book of Euclid; but the truths of mathematics are no less necessary and binding on the great mass of mankind. Some there are who cannot feel the difference between [240] the "Sonata Appassionata" and "Cherry Ripe;" or between a grave-stone-cutter's cherub and the Apollo Belvidere; but the canons of art are none the less acknowledged. While some there may be, who, devoid of sympathy, are incapable of a sense of duty; but neither does their existence affect the foundations of morality. Such pathological deviations from true manhood are merely the halt, the lame, and the blind of the world of consciousness; and the anatomist of the mind leaves them aside, as the anatomist of the body would ignore abnormal specimens.

And as there are Pascals and Mozarts, Newtons and Raffaelles, in whom the innate faculty for science or

art seems to need but a touch to spring into full vigour, and through whom the human race obtains new possibilities of knowledge and new conceptions of beauty: so there have been men of moral genius, to whom we owe ideals of duty and visions of moral perfection, which ordinary mankind could never have attained: though, happily for them, they can feel the beauty of a vision, which lay beyond the reach of their dull imaginations, and count life well spent in shaping some faint image of it in the actual world.

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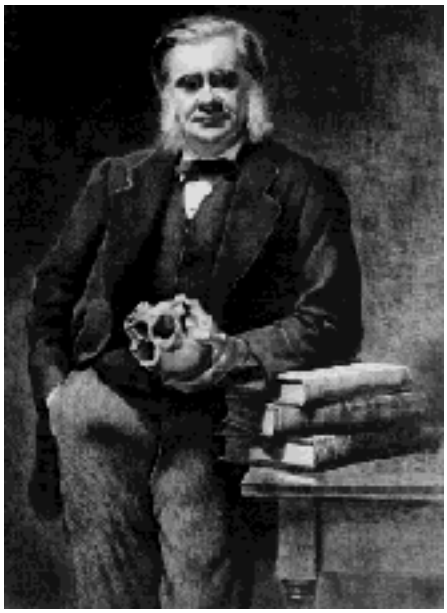
[1] Family affection in the eighteenth century may have been stronger than in the nineteenth; but Hume's bachelor inexperience can surely alone explain his strange account of the suppositions of the marriage law of that day, and their effects. The law certainly abolished all division of possessions, but it did so by making the husband sole proprietor.

[2] Ben Jonson's *Cynthia's Revels,* act i.



Bishop Berkeley on the Metaphysics of Sensation[1] (1871)

Collected Essays VI

[243] Professor Fraser has earned the thanks of all students of philosophy for the conscientious labour which he has bestowed upon his new edition of the works of Berkeley; in which, for the first time, we find collected together every thought which can be traced to the subtle and penetrating mind of the famous Bishop of Cloyne; while the "Life and Letters" will rejoice those who care less for the idealist and the prophet of tar-water, than for the man who stands out as one of the noblest and purest figures of his time: that Berkeley from whom the jealousy of Pope [244] did not withhold a single one of all "the virtues under heaven;" nor the cynicism of Swift, the dignity of "one of the first men of the kingdom for learning and virtue;" the man whom the pious Atterbury could compare to nothing less than an angel; whose personal influence and eloquence filled the Scriblerus Club and the House of Commons with enthusiasm for the evangelization of the North American Indians; and even led Sir Robert Walpole to assent to the appropriation of public money to a scheme which was neither business nor bribery.[2]

Hardly any epoch in the intellectual history of England is more remarkable in itself, or possesses a greater interest for us in these latter days, than that which coincides broadly with the conclusion of the seventeenth and the opening of the eighteenth century. The political fermentation of the preceding age was gradually working itself out; domestic peace gave men time to think; and the toleration won by the party of which Locke was the spokesman, permitted a freedom of speech and of writing such as has rarely been exceeded in later times. Fostered by these circumstances, the great faculty for physical and metaphysical [245] inquiry, with which the people of our race are naturally endowed, developed itself vigorously; and at least two of its products have had a profound and a permanent influence upon the subsequent course of thought in the world. The one of these was English Freethinking; the other, the Theory of Gravitation.

Looking back to the origin of the intellectual impulses of which these were the results, we are led to Herbert, to Hobbes, to Bacon; and to one who stands in advance of all these, as the most typical man of his time–Descartes. It is the Cartesian doubt–the maxim that assent may properly be given to no propositions but such as are perfectly clear and distinct–which, becoming incarnate, so to speak, in the Englishmen, Anthony Collins, Toland, Tindal, Woolston, and in the wonderful Frenchman, Pierre Bayle, reached its final term in Hume. And, on the other hand, although the theory of Gravitation set aside the Cartesian vortices–yet the spirit of the "Principes de Philosophie" attained its apotheosis when Newton demonstrated all the host of heaven to be but the elements of a vast mechanism, regulated by the same laws as those which express the falling of a stone to the ground. There is a passage in the preface to the first edition of the "Principia" which shows that Newton was penetrated, as completely as Descartes, with the belief that all the phenomena of [246] nature[3] are expressible in terms of matter and motion.

"Would that the rest of the phenomena of nature could be deduced by a like kind of reasoning from

mechanical principles. For many circumstances lead me to suspect that all these phenomena may depend upon certain forces, in virtue of which the particles of bodies, by causes not yet known, are either mutually impelled against one another and cohere into regular figures, or repel and recede from one another; which forces being unknown, philosophers have as yet explored nature in vain. But I hope that, either by this method of philosophizing, or by some other and better, the principles here laid down may throw some light upon the matter."[4]

[247] But the doctrine that all the phenomena of nature are resolvable into mechanism is what people have agreed to call "materialism;" and when Locke and Collins maintained that matter may possibly be able to think, and Newton himself could compare infinite space to the sensorium of the Deity, it was not wonderful that the English philosophers should be attacked as they were by Leibnitz in the famous letter to the Princess of Wales, which gave rise to his correspondence with Clarke.[5]

"1. Natural religion itself seems to decay [in England] very much. Many will have human souls to be material; others make God Himself a corporeal Being.

"2. Mr. Locke and his followers are uncertain, at least, whether the soul be not material and naturally perishable.

"3. Sir Isaac Newton says that space is an organ which God makes use of to perceive things by. But if God stands in need of any organ to perceive things by, it will follow that they do not depend altogether upon Him, nor were produced by Him.

[248] "4. Sir Isaac Newton and his followers have also a very odd opinion concerning the work of God. According to their doctrine, God Almighty wants to wind up His watch from time to time; otherwise it would cease to move.[6] He had not, it seems, sufficient foresight to make it a perpetual motion. Nay, the machine of God's making is so imperfect, according to these gentlemen, that He is obliged to clean it now and then by an extraordinary concourse, and even to mend it as a clockmaker mends his work."

It is beside the mark, at present, to inquire how far Leibnitz paints a true picture, and how far he is guilty of a spiteful caricature of Newton's views in these passages; and whether the beliefs which Locke is known to have entertained are consistent with the conclusions which may logically be drawn from some parts of his works. It is undeniable that English philosophy in Leibnitz's time had the general character which he ascribes to it. The phenomena of nature were held to be resolvable into the attractions and the repulsions of particles of matter; all knowledge was attained through the senses; the mind antecedent to experience was a *tabula rasa.* In other words, at the commencement of the eighteenth century, the character of speculative thought in [249] England was essentially sceptical, critical, and materialistic. Why such "materialism"[7] should be more inconsistent with the existence of a Deity, the freedom of the will, or the immortality of the soul, or with any actual or possible system of theology, than "idealism," I must declare myself at a loss to divine. But, in the year 1700, all the world appears to have been agreed, Tertullian notwithstanding, that materialism necessarily leads to very dreadful consequences. And it was

thought that it conduced to the interests of religion and morality to attack the materialists with all the weapons that came to hand. Perhaps the most interesting controversy which arose out of these questions is the wonderful triangular duel between Dodwell, Clarke, and Anthony Collins, concerning the materiality of the soul, and–what all the disputants considered to be the necessary consequence of its materiality–its natural mortality. I do not think that any one can read the letters which passed between Clarke and Collins, without admitting that Collins, who writes with wonderful power and closeness of reasoning, has by far the best of the argument, so far as the possible materiality of the soul goes; and that, in this battle, the Goliath of Freethinking overcame the champion of what was considered Orthodoxy.

In Dublin, all this while, there was a little [250] David practising his youthful strength upon the intellectual lions and bears of Trinity College. This was George Berkeley, who was destined to give the same kind of development to the idealistic side of Descartes' philosophy, that the Freethinkers had given to its sceptical side, and the Newtonians to its mechanical side.

Berkeley faced the problem boldly. He said to the materialists: "You tell me that all the phenomena of nature are resolvable into matter and its affections. I assent to your statement, and now I put to you the further question, 'What is matter?' In answering this question you shall be bound by your own conditions; and I demand, in the terms of the Cartesian axiom, that in turn you give your assent only to such conclusions as are perfectly clear and obvious."

It is this great argument which is worked out in the "Treatise concerning the Principles of Human Knowledge," and in those "Dialogues between Hylas and Philonous," which rank among the most exquisite examples of English style, as well as among the subtlest of metaphysical writings; and the final conclusion of which is summed up in a passage remarkable alike for literary beauty, and for calm audacity of statement.

[251] "Some truths there are so near and obvious to the mind that a man need only open his eyes to see them. Such I take this important one to be, viz., that all the choir of heaven and furniture of the earth–in a word, all those bodies which compose the mighty frame of the world–have not any substance without a mind; that their being is to be perceived or known; that consequently, so long as they are not actually perceived by me, or do not exist in my mind or that of any other created spirit, they must either have no existence at all or else subsist in the mind of some eternal spirit; it being perfectly unintelligible, and involving all the absurdity of abstraction, to attribute to any single part of them an existence independent of a spirit."[8]

Doubtless this passage sounds like the acme of metaphysical paradox, and we all know that "coxcombs vanquished Berkeley with a grin;" while common-sense folk refuted him by stamping on the ground, or some such other irrelevant proceeding. But the key to all philosophy lies in the clear apprehension of Berkeley's problem–which is neither more nor less than one of the shapes of the greatest of all questions, "What are the limits of our faculties?" And it is worth any amount of trouble to comprehend the exact nature of the argument by which Berkeley arrived at his results, and to know by one's own knowledge the great truth which he discovered–that the honest and rigorous following up of the argument which leads us to "materialism," inevitably carries us beyond it.

Suppose that I accidentally prick my finger with a pin. I immediately become aware of a [252] condition of my consciousness–a feeling which I term pain. I have no doubt whatever that the feeling is in myself alone; and if any one were to say that the pain I feel is something which inheres in the needle, as one of the qualities of the substance of the needle, we should all laugh at the absurdity of the phraseology. In fact, it is utterly impossible to conceive pain except as a state of consciousness.

Hence, so far as pain is concerned, it is sufficiently obvious that Berkeley's phraseology is strictly applicable to our power of conceiving its existence–"its being is to be perceived or known," and "so long as it is not actually perceived by me, or does not exist in my mind, or that of any other created spirit, it must either have no existence at all, or else subsist in the mind of some eternal spirit."

So much for pain. Now let us consider an ordinary sensation. Let the point of the pin be gently rested upon the skin, and I become aware of a feeling, or condition of consciousness, quite different from the former–the sensation of what I call "touch." Nevertheless this touch is plainly just as much in myself as the pain was. I cannot for a moment conceive this something which I call touch as existing apart from myself, or a being capable of the same feelings as myself. And the same reasoning applies to all the other simple sensations. A moment's reflection is suffi[253]cient to convince one that the smell, and the taste, and the yellowness, of which we become aware when an orange is smelt, tasted, and seen, are as completely states of our consciousness as is the pain which arises if the orange happens to be too sour. Nor is it less clear that every sound is a state of the consciousness of him who hears it. If the universe contained only blind and deaf beings, it is impossible for us to imagine but that darkness and silence should reign everywhere.

It is undoubtedly true, then, of all the simple sensations that, as Berkeley says, their "*esse* is *percipi* "–their being is to be "perceived or known." But that which perceives, or knows, is termed mind or spirit; and therefore the knowledge which the senses give us is, after all, a knowledge of spiritual phenomena.

All this was explicitly or implicitly admitted, and, indeed, insisted upon, by Berkeley's contemporaries, and by no one more strongly than by Locke, who terms smells, tastes, colours, sounds, and the like, "secondary qualities," and observes, with respect to these "secondary qualities," that "whatever reality we by mistake attribute to them [they] are in truth nothing in the objects themselves."

And again: "Flame is denominated hot and light; snow, white and cold; and manna, white and sweet, from the ideas they produce in us; which qualities are commonly thought to be the [254] same in these bodies; that those ideas are in us, the one the perfect resemblance of the other as they are in a mirror; and it would by most men be judged very extravagant if one should say otherwise. And yet he that will consider that the same fire that at one distance produces in us the sensation of warmth, does at a nearer approach produce in us the far different sensation of pain, ought to bethink himself what reason he has to say that his idea of warmth, which was produced in him by the fire, is actually in the fire; and his idea of pain which the same fire produced in him in the same way, is not in the fire. Why are whiteness and coldness in snow, and pain not, when it produces the one and the other idea in us; and can do neither but by the bulk, figure, number, and motion of its solid parts?"[9]

Thus far then materialists and idealists are agreed. Locke and Berkeley, and all logical thinkers who have succeeded them, are of one mind about secondary qualities–their being is to be perceived or known–their materiality is, in strictness, a spirituality.

But Locke draws a great distinction between the secondary qualities of matter, and certain others which he terms "primary qualities." These are extension, figure, solidity, motion and rest, and number; and he is as clear that these [255] primary qualities exist independently of the mind, as he is that the secondary qualities have no such existence.

"The particular bulk, number, figure, and motion of the parts of fire and snow are really in them, whether any one's senses perceive them or not, and therefore they may be called real qualities, because they really exist in those bodies; but light, heat, whiteness, or coldness, are no more really in them, than sickness, or pain, is in manna. Take away the sensation of them; let not the eyes see light or colours, nor the ears hear sounds; let the palate not taste, nor the nose smell; and all colours, tastes, odours and sounds, as they are such particular ideas, vanish and cease, and are reduced to their causes, *i.e.* bulk, figure, and motion of parts.

"18. A piece of manna of sensible bulk is able to produce in us the idea of a round or square figure; and, by being removed from one place to another, the idea of motion. This idea of motion represents it as it really is in the manna moving; a circle and square are the same, whether in idea or existence, in the mind or in the manna; and thus both motion and figure are really in the manna, whether we take notice of them or no: this everybody is ready to agree to."

So far as primary qualities are concerned, then, Locke is as thoroughgoing a realist as St. Anselm. In Berkeley, on the other hand, we have as complete a representative of the nominalists and conceptualists–an intellectual descendant of Roscellinus and of Abelard.[10] And by a curious irony of fate, it is the nominalist who is, this time, the champion of orthodoxy, and the realist that of heresy.

Once more let us try to work out Berkeley's [256] principles for ourselves, and inquire what foundation there is for the assertion that extension, form, solidity, and the other "primary qualities," have an existence apart from mind. And for this purpose let us recur to our experiment with the pin.

It has been seen that when the finger is pricked with a pin, a state of consciousness arises which we call pain; and it is admitted that this pain is not a something which inheres in the pin, but a something which exists only in the mind, and has no similitude elsewhere.

But a little attention will show that this state of consciousness is accompanied by another, which can by no effort be got rid of. I not only have the feeling, but the feeling is localized. I am just as certain that the pain is in my finger, as I am that I have it at all. Nor will any effort of the imagination enable me to believe that the pain is not in my finger.

And yet nothing is more certain than that it is not, and cannot be, in the spot in which I feel it, nor within a couple of feet of that spot. For the skin of the finger is connected by a bundle of fine nervous fibres, which run up the whole length of the arm, to the spinal marrow, which sets them in communication with the brain, and we know that the feeling of pain caused by the prick of a pin is dependent on the integrity of those fibres. After they have been cut through close to the spinal cord, no pain will be felt, whatever injury [257] is done to the finger; and if the ends which remain in connection with the cord be pricked, the pain which arises will appear to have its seat in the finger just as distinctly as before. Nay, if the whole arm be cut off, the pain which arises from pricking the nerve stump will appear to be seated in the fingers, just as if they were still connected with the body.

It is perfectly obvious, therefore, that the localization of the pain at the surface of the body is an act of the mind. It is an *extradition* of that consciousness, which has its seat in the brain, to a definite point of the body–which takes place without our volition, and may give rise to ideas which are contrary to fact. We might call this extradition of consciousness a reflex feeling, just as we speak of a movement which is excited apart from, or contrary to, our volition, as a reflex motion. Locality is no more in the pin than pain is; of the former, as of the latter, it is true that "its being is to be perceived," and that its existence apart from a thinking mind is not conceivable.

The foregoing reasoning will be in no way affected, if, instead of pricking the finger, the point of the pin rests gently against it, so as to give rise merely to a tactile sensation. The tactile sensation is referred outwards to the point touched, and seems to exist there. But it is certain that it is not and cannot be there really, [258] because the brain is the sole seat of consciousness; and, further, because evidence, as strong as that in favour of the sensation being in the finger, can be brought forward in support of propositions which are manifestly absurd. For example, the hairs and nails are utterly devoid of sensibility, as every one knows. Nevertheless, if the ends of the nails or hairs are touched, ever so lightly, we feel that they are touched, and the sensation seems to be situated in the nails or hairs. Nay more, if a walking-stick, a yard long, is held firmly by the handle and the other end is touched, the tactile sensation, which is a state of our own consciousness, is unhesitatingly referred to the end of the stick; and yet no one will say that it is there.

Let us now suppose that, instead of one pin's point resting against the end of my finger, there are two. Each of these can be known to me, as we have seen, only as a state of a thinking mind, referred outwards, or localized. But the existence of these two states, somehow or other, generates in my mind a number of new ideas, which did not make their appearance when only one state was present. For example, I get the ideas of co-existence, of number, of distance, and of relative place or direction. But all these ideas are ideas of relations, and may be said to imply the existence of something which perceives those relations. If a tactile sensation is a state of the mind, and if [259] the localization of that sensation is an act of the mind, how is it conceivable that a relation between two localized sensations should exist apart from the mind? It is, I confess, quite as easy for me to imagine that redness may exist apart from a visual sense, as it is to suppose that co-existence, number, and distance can have any existence apart from the mind of which they are ideas.

Thus it seems clear that the existence of some, at any rate, of Locke's primary qualities of matter, such as number and extension, apart from mind, is as utterly unthinkable as the existence of colour and sound under like circumstances.

Will the others–namely, figure, motion and rest, and solidity–withstand a similar criticism? I think not. For all these, like the foregoing, are perceptions by the mind of the relations of two or more sensations to one another. If distance and place are inconceivable, in the absence of the mind of which they are ideas, the independent existence of figure, which is the limitation of distance, and of motion, which is change of place, must be equally inconceivable. Solidity requires more particular consideration, as it is a term applied to two very different things, the one of which is solidity of form, or geometrical solidity; while the other is solidity of substance, or mechanical solidity. If those motor nerves of a man by which volitions are converted into motion were all paralysed, and [260] if sensation remained only in the palm of his hand (which is a conceivable case), he would still be able to attain to clear notions of extension, figure, number, and motion by attending to the states of consciousness which might be aroused by the contact of bodies with the sensory surface of the palm. But it does not appear that such a person could arrive at any conception of geometrical solidity. For that which does not come in contact with the sensory surface is non-existent for the sense of touch; and a solid body, impressed upon

the palm of the hand, gives rise only to the notion of the extension of that particular part of the solid which is in contact with the skin.

Nor is it possible that the idea of outness (in the sense of discontinuity with the sentient body) could be attained by such a person; for, as we have seen, every tactile sensation is referred to a point either of the natural sensory surface itself, or of some solid in continuity with that surface. Hence it would appear that the conception of the difference between the Ego and the non-Ego could not be attained by a man thus situated. His feelings would be his universe, and his tactile sensations his "mœnia mundi." Time would exist for him as for us, but space would have only two dimensions.

But now remove the paralysis from the motor apparatus, and give the palm of the hand of our [261] imaginary man perfect freedom to move, so as to be able to glide in all directions over the bodies with which it is in contact. Then with the consciousness of that mobility, the notion of space of three dimensions–which is "*Raum*," or "room" to move with perfect freedom–is at once given. But the notion that the tactile surface itself moves, cannot be given by touch alone, which is competent to testify only to the fact of change of place, not to its cause. The idea of the motion of the tactile surface could not, in fact, be attained, unless the idea of change of place were accompanied by some state of consciousness, which does not exist when the tactile surface is immoveable. This state of consciousness is what is termed the muscular sense, and its existence is very easily demonstrable.

Suppose the back of my hand to rest upon a table, and a sovereign to rest upon the upturned palm, I at once acquire a notion of extension, and of the limit of that extension. The impression made by the circular piece of gold is quite different from that which would be made by a triangular, or a square, piece of the same size, and thereby I arrive at the notion of figure. Moreover, if the sovereign slides over the palm, I acquire a distinct conception of change of place or motion, and of the direction of that motion. For as the sovereign slides, it affects new nerve-endings, and gives rise to new states of consciousness. Each of them is [262] definitely and separately localized by a reflex act of the mind, which, at the same time, becomes aware of the difference between two successive localizations; and therefore of change of place, which is motion.

If, while the sovereign lies on the hand, the latter being kept quite steady, the fore-arm is gradually and slowly raised; the tactile sensations, with all their accompaniments, remain exactly as they were. But, at the same time, something new is introduced; namely, the sense of effort. If I try to discover where this sense of effort seems to be, I find myself somewhat perplexed at first; but, if I hold the fore-arm in position long enough, I become aware of an obscure sense of fatigue, which is apparently seated either in the muscles of the arm, or in the integument directly over them. The fatigue seems to be related to the sense of effort, in much the same way as the pain which supervenes upon the original sense of contact, when a pin is slowly pressed against the skin, is related to touch.

A little attention will show that this sense of effort accompanies every muscular contraction by which the limbs, or other parts of the body, are moved. By its agency the fact of their movement is known; while the direction of the motion is given by the accompanying tactile sensations. And, in consequence of the incessant association of the muscular and the tactile sensations, they [263] become so fused together that they are often confounded under the same name.

If freedom to move in all directions is the very essence of that conception of space of three dimensions which we obtain by the sense of touch; and if that freedom to move is really another name for the feeling of unopposed effort, accompanied by that of change of place, it is surely impossible to conceive of such space as having

existence apart from that which is conscious of effort.

But it may be said that we derive our conception of space of three dimensions not only from touch, but from vision; that if we do not feel things actually outside us, at any rate we see them. And it was exactly this difficulty which presented itself to Berkeley at the outset of his speculations. He met it, with characteristic boldness, by denying that we do see things outside us; and, with no less characteristic ingenuity, by devising that "New Theory of Vision" which has met with wider acceptance than any of his views, though it has been the subject of continual controversies.[11]

In the "Principles of Human Knowledge," Berkeley himself tells us how he was led to those [264] opinions which he published in the "Essay towards the New Theory of Vision."

"It will be objected that we see things actually without, or at a distance from us, and which consequently do not exist in the mind; it being absurd that those things which are seen at the distance of several miles, should be as near to us as our own thoughts. In answer to this, I desire it may be considered that in a dream we do oft perceive things as existing at a great distance off, and yet, for all that, those things are acknowledged to have their existence only in the mind.

"But for the fuller clearing of this point, it may be worth while to consider how it is that we perceive distance and things placed at a distance by sight. For that we should in truth see external space and bodies actually existing in it, some nearer, others further off, seems to carry with it some opposition to what hath been said of their existing nowhere without the mind. The consideration of this difficulty it was that gave birth to my "Essay towards the New Theory of Vision" which was published not long since, wherein it is shown that distance, or outness, is neither immediately of itself perceived by sight, nor yet apprehended, or judged of, by lines and angles or anything that hath any necessary connection with it; but that it is only suggested to our thoughts by certain visible ideas and sensations attending vision, which, in their own nature, have no manner of similitude or relation either with distance or with things placed at a distance; but by a connection taught us by experience, they come to signify and suggest them to us, after the same manner that words of any language suggest the ideas they are made to stand for; insomuch that a man born blind and afterwards made to see, would not, at first sight, think the things he saw to be without his mind or at any distance from him."

The key-note of the Essay to which Berkeley refers in this passage is to be found in an italicized paragraph of section 127:–

[265] "*The extensions, figures, and motions perceived by sight are specifically distinct from the ideas of touch called by the same names; nor is there any such thing as an idea or kind of idea common to both senses.*"

It will be observed that this proposition expressly declares that extension, figure, and motion, and consequently distance, are immediately perceived by sight as well as by touch; but that visual distance, extension, figure, and motion, are totally different in quality from the ideas of the same name obtained through the sense of touch. And other passages leave no doubt that such was Berkeley's meaning. Thus in the 112th section of the same Essay, he carefully defines the two kinds of distance, one visual, the other tangible:–

"By the distance between any two points nothing more is meant than the number of intermediate points. If the given points are visible, the distance between them is marked out by the number of interjacent visible points; if

they are tangible, the distance between them is a line consisting of tangible points."

Again, there are two sorts of magnitude or extension:–

"It has been shown that there are two sorts of objects apprehended by sight, each whereof has its distinct magnitude or extension: the one properly tangible, *i.e.*, to be perceived and measured by touch, and not immediately falling under the sense of seeing; the other properly and immediately visible, by mediation of which the former is brought into view."–§ 55.

But how are we to reconcile these passages with others which will be perfectly familiar to every [266] reader of the "New Theory of Vision"? As, for example:–

"It is, I think, agreed by all, that distance of itself, and immediately, cannot be seen."–§ 2.

"Space or distance, we have shown, is no otherwise the object of sight than of hearing."–§ 130.

"Distance is in its own nature imperceptible, and yet it is perceived by sight. It remains, therefore, that it is brought into view by means of some other idea, that is itself immediately perceived in the act of vision."–§ 11.

"Distance or external space."–§ 155.

The explanation is quite simple, and lies in the fact that Berkeley uses the word "distance" in three senses. Sometimes he employs it to denote visible distance, and then he restricts it to distance in two dimensions, or simple extension. Sometimes he means tangible distance in two dimensions; but most commonly he intends to signify tangible distance in the third dimension. And it is in this sense that he employs "distance" as the equivalent of "space." Distance in two dimensions is, for Berkeley, not space, but extension. By taking a pencil and interpolating the words "visible" and "tangible" before "distance" wherever the context renders them necessary, Berkeley's statements may be made perfectly consistent; though he has not always extricated himself from the entanglement caused by his own loose phraseology, which rises to a climax in the last ten sections of the "Theory of Vision," in which he endeavours to prove that a pure intelli[267]gence able to see, but devoid of the sense of touch, could have no idea of a plane figure. Thus he says in section 156:–

"All that is properly perceived by the visual faculty amounts to no more than colours with their variations and different proportions of light and shade; but the perpetual mutability and fleetingness of those immediate objects of sight render them incapable of being managed after the manner of geometrical figures, nor is it in any degree useful that they should. It is true there be divers of them perceived at once, and more of some and less of others; but accurately to compute their magnitude, and assign precise determinate proportions between things so variable and inconstant, if we suppose it possible to be done, must yet be a very trifling and insignificant labour."

If, by this, Berkeley means that by vision alone, a straight line cannot be distinguished from a curved one, a circle from a square, a long line from a short one, a large angle from a small one, his position is surely absurd in itself and contradictory to his own previously cited admissions; if he only means, on the other hand, that his pure spirit could not get very far on in his geometry, it maybe true or not; but it is in contradiction with his previous assertion, that such a pure spirit could never attain to know as much as the first elements of plane geometry.

Another source of confusion, which arises out of Berkeley's insufficient exactness in the use of language, is to be found in what he says about solidity, in discussing Molyneux's problem, whether a man born blind and having learned to dis[268]tinguish between a cube and a sphere, could, on receiving his sight, tell the one from the other by vision. Berkeley agrees with Locke that he could not, and adds the following reflection:–

"Cube, sphere, table, are words he has known applied to things perceivable by touch, but to things perfectly intangible he never knew them applied. Those words in their wonted application always marked out to his mind bodies or solid things which were perceived by the resistance they gave. But there is no solidity, no resistance or protrusion perceived by sight."

Here "solidity" means resistance to pressure, which is apprehended by the muscular sense; but when in section 154 Berkeley says of his pure intelligence–

"It is certain that the aforesaid intelligence could have no idea of a solid or quantity of three dimensions, which follows from its not having any idea of distance "–

he refers to that notion of solidity which may be obtained by the tactile sense without the addition of any notion of resistance in the solid object; as, for example, when the finger passes lightly over the surface of a billiard ball.

Yet another source of difficulty in clearly understanding Berkeley arises out of his use of the word "outness." In speaking of touch. he seems to employ it indifferently, both for the localization of a tactile sensation in the sensory surface, which we really obtain through touch; and for the notion of corporeal separation, which is attained by the association of muscular and tactile sensa[269]tions. In speaking of sight, on the other hand, Berkeley employs "outness" to denote corporeal separation.

When due allowance is made for the occasional looseness and ambiguity of Berkeley's terminology, and the accessories are weeded out of the essential parts of his famous Essay, his views may, I believe, be fairly and accurately summed up in the following propositions:–

1. The sense of touch gives rise to ideas of extension, figure, magnitude, and motion.

2. The sense of touch gives rise to the idea of "outness," in the sense of localization.

3. The sense of touch gives rise to the idea of resistance, and thence to that of solidity, in the sense of impenetrability.

4. The sense of touch gives rise to the idea of "outness," in the sense of distance in the third dimension, and thence to that of space or geometrical solidity.

5. The sense of sight gives rise to ideas of extension, of figure, magnitude, and motion.

6. The sense of sight does not give rise to the idea of "outness," in the sense of distance in the third dimension, nor to that of geometrical solidity, no visual idea appearing to be without the mind, or at any distance off (§§ 43, 50).

7. The sense of sight does not give rise to the idea of mechanical solidity.

8. There is no likeness whatever between the [270] tactile ideas called extension, figure, magnitude, and motion, and the visual ideas which go by the same names; nor are any ideas common to the two senses.

9. When we think we see objects at a distance, what really happens is that the visual picture suggests that the object seen has tangible distance; we confound the strong belief in the tangible distance of the object with actual sight of its distance.

10. Visual ideas, therefore, constitute a kind of language, by which we are informed of the tactile ideas which will, or may, arise in us.

Taking these propositions into consideration *seriatim,* it may be assumed that every one will assent to the first and second; and that for the third and fourth we have only to include the muscular sense under the name of sense of touch, as Berkeley did, in order to make it quite accurate. Nor is it intelligible to me that any one should explicitly deny the truth of the fifth proposition, though some of Berkeley's supporters, less careful than himself, have done so. Indeed, it must be confessed that it is only grudgingly, and as it were against his will, that Berkeley admits that we obtain ideas of extension, figure, and magnitude by pure vision, and that he more than half retracts the admission; while he absolutely denies that sight gives us any notion of outness in either sense of the word, and even declares that "no proper visual idea appears to be without the mind, [271] or at any distance off." By "proper visual ideas," Berkeley denotes colours, and light, and shade; and, therefore, he affirms that colours do not appear to be at any distance from us. I confess that this assertion appears to me to be utterly unaccountable. I have made endless experiments on this point, and by no effort of the imagination can I persuade myself, when looking at a colour, that the colour is in my mind, and not at a "distance off," though of course I know perfectly well, as a matter of reason, that colour is subjective. It is like looking at the sun setting, and trying to persuade one's self that the earth appears to move and not the sun, a feat I have never been able to accomplish. Even when the eyes are shut, the darkness of which one is conscious, carries with it the notion of outness. One looks, so to speak, into a dark space. Common language expresses the common experience of mankind in this matter. A man will say that a smell is in his nose, a taste is in his mouth, a singing is in his ears, a creeping or a warmth is in his skin; but if he is jaundiced, he does not say that he has yellow in his eyes, but that everything looks yellow; and if he is troubled with *muscæ volitantes,* he says, not that he has specks in his eyes, but that he sees specks dancing before his eyes. In fact, it appears to me that it is the special peculiarity of visual sensations, that they invariably give rise to the idea of remoteness, and that Berkeley's dictum [272] ought to be reversed. For I think that any one who interrogates his consciousness carefully will find that "every proper visual idea" appears to be without the mind and at a distance off.

Not only does every *visibile* appear to be remote, but it has a position in external space, just as a *tangibile* appears to be superficial and to have a determinate position on the surface of the body. Every *visibile,* in fact, appears (approximately) to be situated upon a line drawn from it to the point of the retina on which its image falls. It is referred outwards, in the general direction of the pencil of light by which it is rendered visible, just as, in the experiment with the stick, the *tangibile* is referred outwards to the end of the stick.

It is for this reason that an object, viewed with both eyes, is seen single and not double. Two distinct images are formed, but each image is referred to that point at which the two optic axes intersect; consequently, the two

images cover one another, and appear as completely one as any other two equally similar superimposed images would be.[12] And it is for the same reason, that, if the side of the ball of the eye is pressed upon at any point, a spot of light appears apparently outside the eye, and in a region exactly opposite to that in which the pressure is made.

But while it seems to me that there is no reason [273] to doubt that the extradition of sensation is more complete in the case of the eye than in that of the skin, and that corporeal distinctness, and hence space, are directly suggested by vision, it is another, and a much more difficult question, whether the notion of geometrical solidity is attainable by pure vision; that is to say, by a single eye, all the parts of which are immoveable. However this may be for an absolutely fixed eye, I conceive there can be no doubt in the case of an eye that is moveable and capable of adjustment. For, with the moveable eye, the muscular sense comes into play in exactly the same way as with the moveable hand; and the notion of change of place, *plus* the sense of effort, gives rise to a conception of visual space, which runs exactly parallel with that of tangible space. When two moveable eyes are present, the notion of space of three dimensions is obtained in the same way as it is by the two hands, but with much greater precision.[13] And if, to take a case similar to one already assumed, we suppose a man deprived of every sense except vision, and of all motion except that of his eyes, it surely cannot be doubted that he would have a perfect conception of space; and indeed a much more perfect conception than he who possessed touch alone without vision. But of course our touchless man would be devoid of any notion of resistance; and hence space, for [274] him, would be altogether geometrical and devoid of body.

And here another curious consideration arises, what likeness, if any, would there be between the visual space of the one man, and the tangible space of the other?

Berkeley, as we have seen (in the eighth proposition), declares that there is no likeness between the ideas given by sight and those given by touch; and one cannot but agree with him, so long as the term ideas is restricted to mere sensations. Obviously, there is no more likeness between the feel of a surface and the colour of it, than there is between its colour and its smell. All simple sensations, derived from different senses, are incommensurable with one another, and only gradations of their own intensity are comparable. And thus, so far as the primary facts of sensation go, visual figure and tactile figure, visual magnitude and tactile magnitude, visual motion and tactile motion, are truly unlike, and have no common term. But when Berkeley goes further than this, and declares that there are no "ideas" common to the "ideas" of touch and those of sight, it appears to me that he has fallen into a great error, and one which is the chief source of his paradoxes about geometry.

Berkeley in fact employs the word "idea," in this instance, to denote two totally different classes of feelings, or states of consciousness. For these [275] may be divided into two groups: the primary feelings, which exist in themselves and without relation to any other, such as pleasure and pain, desire, and the simple sensations obtained through the sensory organs; and the secondary feelings, which express those relations of primary feelings which are perceived by the mind; and the existence of which, therefore, implies the pre-existence of at least two of the primary feelings. Such are likeness and unlikeness in quality, quantity, or form succession and contemporaneity; contiguity and distance; cause and effect; motion and rest.

Now it is quite true that there is no likeness between the primary feelings which are grouped under sight and touch; but it appears to me wholly untrue, and indeed absurd, to affirm that there is no likeness between the secondary feelings which express the relations of the primary ones.

The relation of succession perceived between the visible taps of a hammer, is, to my mind, exactly like the relation of succession between the tangible taps; the unlikeness between red and blue is a mental phenomenon of the same order as the unlikeness between rough and smooth. Two points visibly distant are so because one or more units of visible length (*minima visibilia*) are interposed between them; and as two points tangibly distant are so, because one or more units of tangible length (*minima tangibilia*) are interposed between them, it is clear that the notion of [276] interposition of units of sensibility, or *minima sensibilia,* is an idea common to the two. And whether I see a point move across the field of vision towards another point, or feel the like motion, the idea of the gradual diminution of the number of sensible units between the two points appears to me to be common to both kinds of motion.

Hence, I conceive, that though it be true that there is no likeness between the primary feelings given by sight and those given by touch, yet there is a complete likeness between the secondary feelings aroused by each sense.

Indeed, if it were not so, how could Logic, which deals with those forms of thought which are applicable to every kind of subject-matter, be possible? How could numerical proportion be as true of *visibilia,* as of *tangibilia,* unless there were some ideas common to the two? And to come directly to the heart of the matter, is there any more difference between the relations between tangible sensations which we call place and direction, and those between visible sensations which go by the same name, than there is between those relations of tangible and visible sensations which we call succession? And if there be none, why is Geometry not just as much a matter of *visibilia* as of *tangibilia*?

Moreover, as a matter of fact, it is certain that the muscular sense is so closely connected with both the visual and the tactile senses, that, by [277] the ordinary laws of association, the ideas which it suggests must needs be common to both.

From what has been said it will follow that the ninth proposition falls to the ground; and that vision, combined with the muscular sensations produced by the movement of the eyes, gives us as complete a notion of corporeal separation and of distance in the third dimension of space, as touch, combined with the muscular sensations produced by the movements of the hand, does. The tenth proposition seems to contain a perfectly true statement, but it is only half the truth. It is no doubt true that our visual ideas are a kind of language by which we are informed of the tactile ideas which may or will arise in us; but this is true, more or less, of every sense in regard to every other. If I put my hand in my pocket, the tactile ideas which I receive prophesy quite accurately what I shall see–whether a bunch of keys or half-a-crown–when I pull it out again; and the tactile ideas are, in this case, the language which informs me of the visual ideas which will arise. So with the other senses: olfactory ideas tell me I shall find the tactile and visual phenomena called violets, if I look for them; taste, combined with touch, tells me that what I am tasting and touching with the tongue will, if I look at it, have the form of a clove; and hearing warns me of what I shall, or may, see and touch every minute of my life.

[278] But while the "New Theory of Vision" cannot be considered to possess much value in relation to the immediate object its author had in view, it had a vastly important influence in directing attention to the real complexity of many of those phenomena of sensation, which appear at first to be simple. And even if Berkeley, as I imagine, was quite wrong in supposing that we do not see space, the contrary doctrine makes quite as strongly for his general view, that space can be conceived only as something thought by a mind.

The last of Locke's "primary qualities" which remain to be considered is mechanical solidity, or impenetrability.

But our conception of this is derived from the sense of resistance to our own effort, or active force, which we meet with in association with sundry tactile or visual phenomena; and, undoubtedly, active force is inconceivable except as a state of consciousness. This may sound paradoxical; but let any one try to realize what he means by the mutual attraction of two particles, and I think he will find, either, that he conceives them simply as moving towards one another at a certain rate, in which ease he only pictures motion to himself, and leaves force aside; or, that he conceives each particle to be animated by something like his own volition, and to be pulling as he would pull. And I suppose that this difficulty of thinking of force except as something comparable to volition lies at the bottom of [279] Leibnitz's doctrine of monads, to say nothing of Schopenhauer's "Welt als Wille und Vorstellung;" while the opposite difficulty of conceiving force to be anything like volition, drives another school of thinkers into the denial of any connection, save that of succession, between cause and effect.

To sum up. If the materialist affirms that the universe and all its phenomena are resolvable into matter and motion, Berkeley replies, True; but what you call matter and motion are known to us only as forms of consciousness; their being is to be conceived or known; and the existence of a state of consciousness, apart from a thinking mind, is a contradiction in terms.

I conceive that this reasoning is irrefragable. And therefore, if I were obliged to choose between absolute materialism and absolute idealism, I should feel compelled to accept the latter alternative. Indeed, upon this point Locke does, practically, go as far in the direction of idealism as Berkeley, when he admits that "the simple ideas we receive from sensation and reflection are the boundaries of our thoughts, beyond which the mind, whatever efforts it would make, is not able to advance one jot."–Book II. chap. xxiii. § 29.

But Locke adds, "Nor can it make any discoveries when it would pry into the nature and hidden causes of these ideas."

Now, from this proposition, the thorough mate[280]rialists dissent as much, on the one hand, as Berkeley does, upon the other hand.

The thorough materialist asserts that there is a something which he calls the "substance" of matter; that this something is the cause of all phenomena, whether material or mental; that it is self-existent and eternal, and so forth.

Berkeley, on the contrary, asserts, with equal confidence, that there is no substance of matter, but only a substance of mind, which he terms spirit; that there are two kinds of spiritual substance, the one eternal and uncreated, the substance of the Deity, the other created, and, once created, naturally eternal; that the universe, as known to created spirits, has no being in itself, but is the result of the action of the substance of the Deity on the substance of those spirits.

In contradiction to which bold assertion, Locke affirms that we simply know nothing about substance of any kind.[14]

"So that if any one will examine himself concerning his notion of pure substance in general, he will find he has no other idea of it at all, but only a supposition of he knows not what support of such qualities, which are capable of producing simple ideas in us, which qualities are commonly called accidents.

"If any one should be asked, what is the subject wherein [281] colour or weight inheres? he would have nothing to say but the solid extended parts; and if he were demanded what is it that solidity and extension inhere in? he would not be in much better case than the Indian before mentioned, who, urging that the world was supported by a great elephant, was asked what the elephant rested on? to which his answer was, a great tortoise. But being again pressed to know what gave support to the broad-backed tortoise? replied, something, he knew not what. And thus here, as in all other cases when we use words without having clear and distinct ideas, we talk like children, who, being questioned what such a thing is, readily give this satisfactory answer, that it is something; which in truth signifies no more when so used, either by children or men, but that they know not what, and that the thing they pretend to talk and know of is what they have no distinct idea of at all, and are, so, perfectly ignorant of it and in the dark. The idea, then, we have, to which we give the general name substance, being nothing but the supposed but unknown support of those qualities we find existing, which we imagine cannot exist *sine re substante,* without something to support them, we call that support *substantia,* which, according to the true import of the word, is, in plain English, standing under or upholding."[15]

I cannot but believe that the judgment of Locke is that which Philosophy will accept as her final decision.

Suppose that a rational piano were conscious of sound, and of nothing else. It would be acquainted with a system of nature entirely composed of sounds, and the laws of nature would be the laws of melody and of harmony. It might acquire endless ideas of likeness and unlikeness, of succession, of similarity and dissimilarity, but it [282] could attain to no conception of space, of distance, or of resistance; or of figure, or of motion.

The piano might then reason thus: All my knowledge consists of sounds and the perception of the relations of sounds; now the being of sound is to be heard; and it is inconceivable that the existence of the sounds I know, should depend upon any other existence than that of the mind of a hearing being

This would be quite as good reasoning as Berkeley's, and very sound and useful, so far as it defines the limits of the piano's faculties. But for all that, pianos have an existence quite apart from sounds, and the auditory consciousness of our speculative piano would be dependent, in the first place, on the existence of a "substance" of brass, wood, and iron, and, in the second, on that of a musician. But of neither of these conditions of the existence of his consciousness would the phenomena of that consciousness afford him the slightest hint.

So that while it is the summit of human wisdom to learn the limit of our faculties, it may be wise to recollect that we have no more right to make denials, than to put forth affirmatives, about what lies beyond that limit. Whether either mind, or matter, has a "substance" or not, is a problem which we are incompetent to discuss; and it is just as likely that the common notions upon the subject should be correct as any others. [283] Indeed, Berkeley himself makes Philonous wind up his discussions with Hylas, in a couple of sentences which aptly express this conclusion:–

"You see, Hylas, the water of yonder fountain, how it is forced upwards in a round column to a certain height, at which it breaks and falls back into the basin from whence it rose; its ascent as well as its descent proceeding from the same uniform law or principle of gravitation. Just so, the same principles which, at first view, lead to scepticism, pursued to a certain point, bring men back to common sense."

[1] *The Works of George Berkeley, D.D., formerly Bishop of Cloyne, including many of his Works hitherto unpublished, with Preface, Annotations, his Life and Letters, and an Account of his Philosophy.* By A. C. Fraser. Four vols. Oxford: Clarendon Press, 1871.

[2] In justice to Sir Robert, however, it is proper to remark that he declared afterwards, that he gave his assent to Berkeley's scheme for the Bermuda University only because he thought the House of Commons was sure to throw it out.

[3] So far as Descartes is concerned the phenomena of consciousness are excluded from this category. According to his view, animals and man, in so far as he resembles them, are mechanisms. The soul, which alone feels and thinks, is extra-natural–a something divinely created and added to the anthropoid mechanism. He thus provided their favourite resting-place for the supra-naturalistic evolutionists of our day.

Descartes' denial of sensation to the lower animals is a necessary consequence of his hypothesis concerning the nature and origin of the soul. He was too logical a thinker not to be aware that, if he admitted even the most elementary form of consciousness to be a product or a necessary concomitant, of material mechanism, the assumption of the existence of a thinking substance, apart from matter, would become superfluous.–[1894].

[4] Utinam cætera naturæ phlenomena ex principiis mechanicis, eodem argumentandi genere, derivare licet. Nam multa me movent, ut nonnihil suspicer ea omnia ex viribus quibusdam pendere posse, quibus corporum particulæ, per causas nondum cognitas, vel in se mutuo impelluntur et secundum figuras

regulares cohærent vel ab invicem fugantur et recedunt; quibus viribus ignotis, Philosophi hactenus Naturam frustra tentarunt. Spero autem quod vel huic philosophandi modo, vel veriori, aticui, ptincipia hic posita lucem aliquam præbebunt."–Preface to First Edition of *Principia,* May 8, 1686.

[5] *Collection of Papers which passed between the learned late Mr. Leibnitz and Dr. Clarke* .–1717.

[6] Goethe seems to have had this saying of Leibnitz in his mind when he wrote his famous lines–

> "Was wär' ein Gott der nur von aussen stiesse
>
> Im Kreis das All am Finger laufen liesse."

[7] *See* Note A appended to this Essay.

[8] *Treatise concerning the Principles Human Knowledge,* Part 1. § 6.

[9] Locke, *Human Understanding,* Book II. chap. viii. §§ 14, 15.

[10] See note B.

[11] I have not specifically alluded to the writings of Bailey, Mill, Abbott, and others, on this vexed question, not because I have failed to study them carefully, but because this is not a convenient occasion for controversial discussion. Those who are acquainted with the subject, however, will observe that the view I have taken agrees substantially with that of Mr. Bailey.

[12] In the case of a near, solid, external object, such as a cube, this is not the whole story.

[13] *See* Note C

[14] Berkeley virtually makes the same confession of ignorance, when he admits that we can have no idea or notion of a spirit (*Principles of Human Knowledge*, § 138), and the way in which he tries to escape the consequences of this admission, is a splendid example of the floundering of a mired logician.

[15] Locke, *Human Understanding*, Book II. chap. xxiii. § 2.

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[284] APPENDIX

NOTE A (p. 249.).

The horror of "Materialism" which weighs upon the minds of so many excellent people appears to depend, in part, upon the purely accidental connexion of some forms of materialistic philosophy with ethical and religious tenets by which they are repelled; and, partly, on the survival of a very ancient superstition concerning the nature of matter.

This superstition, for the tenacious vitality of which the idealistic philosophers who are, more or less, disciples of Plato and the theologians who have been influenced by them, are responsible, assumes that matter is something, not merely inert and perishable, but essentially base and evil-natured, if not actively antagonistic to, at least a negative dead-weight upon, the good. Judging by contemporary literature, there are numbers of highly cultivated and indeed superior persons to whom the material world is altogether contemptible, who can see nothing in a handful of garden soil, or a rusty nail, but types of the passive and the corruptible.

To modern science, these assumptions are as much out of date as the equally venerable errors, that the sun goes round the earth every four-and-twenty hours, or that water is an elementary body. The handful of soil is a factory thronged with swarms of busy workers; the rusty nail is an aggregation of millions of particles, moving with inconceivable velocity in a dance of infinite complexity yet perfect measure; harmonic with like performances throughout the solar system. If there is good ground for any conclusion, there is such for the belief that [285] the substance of these particles has existed and will exist, that the energy which stirs them has persisted and will persist, without assignable limit, either in the past or the future. Surely, as Heracleitus said of his kitchen with its pots and pans, "Here also are the gods." Little as we have, even yet, learned of the material universe, that little makes for the belief that it is a system of unbroken order and perfect symmetry, of which the form incessantly changes, while the substance and the energy are imperishable.

It will be understood that those who are thoroughly imbued with this view of what is called "matter" find it a little difficult to understand why that which is termed "mind" should give itself such airs of superiority over the twin sister; to whom, so far as our planet is concerned, it might be hazardous to deny the right of primogeniture.

Accepting the ordinary view of mind, it is a substance the properties of which are states of consciousness, on the one hand, and energy of the same order as that of the material world (or else it would not be able to affect the latter) on the other hand. It is admitted that chance has no more place in the world of mind, than it has in that of matter. Sensations, emotions, intellections are subject to an order, as strict and inviolable as that which obtains among material things. If the order which obtains in the material world lays it open to the reproach of subjection to "blind necessity," the demonstrable existence of a similar order amidst the phenomena of consciousness (and without the belief in that fixed order, logic has no binding force and morals have no foundation) renders it obnoxious to the same condemnation. For necessity is necessity, and whether it is blind or sharp-eyed is nothing to the purpose.

Even if the supposed energy of the substance of mind is sometimes exerted without any antecedent cause–which is the only intelligible sense of the popular doctrine of free-will–the occurrence is admittedly exceptional, and, by the nature of the case, it is not susceptible of proof. Moreover, if the hypothetical substance of mind is possessed of energy, I, for my part, am unable to see how it is to be discriminated from the hypothetical substance of matter.

[286] Thus, if any man think he has reason to believe that the "substance" of matter, to the existence of which no limit can be set either in time or space, is the infinite and eternal substratum of all actual and possible existences, which is the doctrine of philosophical materialism, as I understand it, I have no objection to his holding that doctrine; and I fail to comprehend how it can have the slightest influence upon any ethical or religious views he may please to hold. If matter is the substratum of any phenomena of consciousness, animal or human, then it may possibly be the substratum of any other such phenomena; if matter is imperishable, then it must be admitted to be possible that some of its combinations may be indefinitely enduring, just as our present so-called "elements" are probably only compounds which have bcen indissoluble, in our planet, for millions of years. Moreover, the ultimate forms of existence which we distinguish in our little speck of the universe are, possibly, only two out of infinite varieties of existence, not only analogous to matter and analogous to mind, but of kinds which we are not competent so much as to conceive–in the midst of which, indeed, we might be set down, with no more notion of what was about us, than the worm in a flower-pot, on a London balcony, has of the life of the great city.

That which I do very strongly object to is the habit, which a great many non-philosophical materialists unfortunately fall into, of forgetting all these very obvious considerations. They talk as if the proof that the "substance of matter" was the "substance" of all things cleared up all the mysteries of existence. In point of fact, it leaves them exactly where they were.

The philosophical Materialist who takes the trouble to comprehend Berkeley finds that strict logic carries him no further than some such answer as this to the philosophical Idealist: Well, if I cannot show that you are wrong, you cannot show that I am; if I should happen to be right, your proofs of the impossibility of knowing anything but states of consciousness would be as valid as they are now; moreover, your religious and ethical difficulties are just as great as mine. The speculative game is drawn–let us get to practical work.

[287] NOTE B (p. 255).

I am afraid this paragraph is very faulty, and indeed misleading.

Scholastic "Realism" means the doctrine that generic conceptions have an objective existence apart from the human mind. Conceptualism asserts that they exist only in the mind; nominalism, that general terms are mere names indicative of the similarities of objective existences.

Locke's assertion that "motion and figure are really in the manna" is essentially a piece of realism in the scholastic sense. Berkeley would reply motion and figure are purely mental existences–abolish all minds, and what becomes of them? But that does not make him into a conceptualist, still less into a nominalist, and though he may have reached his ultimate position through conceptualism, his position is quite different.

Berkeley differs from all his predecessors in affirming that the only substantial existence is the hypothetical substratum of mind or "spirit"; and that the whole phenomenal world consists of nothing more than affections of human (and other?) spirits by the divine spirit. Pushed to its logical extreme, his system passes into pantheism pure and simple.

NOTE C (p. 273).

To any one who possesses the faculty of squinting I recommend the following experiment. Take two of the ordinary figures of a cube, drawn for the stereoscope, and place them some few inches apart on a screen or wall, the proper right hand figure being on the left and the proper left on the right; then squint so as to see the left hand figure with the right eye and the right with the left eye. After a little practice, there will suddenly appear, at the point of intersection of the lines prolonging the two optic axes, and apparently, suspended in the air, a figure of a cube. And this image of the cube is so real that a pencil held in the hand can be moved all round it, or driven through it.

THE HUXLEY FILE

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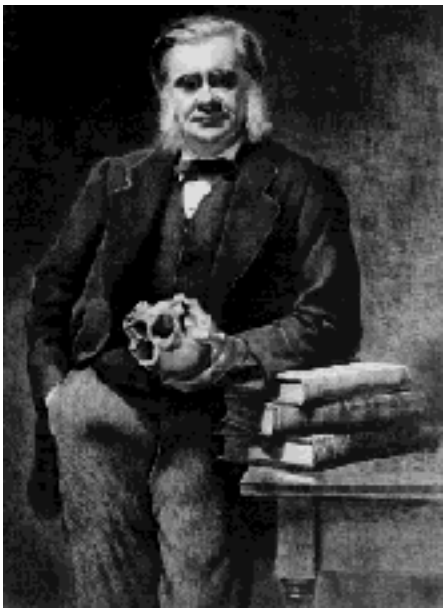

On Sensation and the Unity of Structure of Sensiferous Organs (1879)

Collected Essays VI

[288] The maxim that metaphysical inquiries are barren of result, and that the serious occupation of the mind with them is a mere waste of time and labour, finds much favour in the eyes of the many persons who pride themselves on the possession of sound common sense; and we sometimes hear it enunciated by weighty authorities, as if its natural consequence, the suppression of such studies, had the force of a moral obligation.

In this case, however, as in some others, those who lay down the law seem to forget that a wise legislator will consider, not merely whether his proposed enactment is desirable, but whether obedience to it is possible. For, if the latter question is answered negatively, the former is surely hardly worth debate.

[289] Here, in fact, lies the pith of the reply to those who would make metaphysics contraband of intellect. Whether it is desirable to place a prohibitory duty upon philosophical speculations or not, it is utterly impossible to prevent the importation of them into the mind. And it is not a little curious to observe that those who most loudly profess to abstain from such commodities are, all the while, unconscious consumers, on a great scale, of one or other of their multitudinous disguises or adulterations. With mouths full of the particular kind of heavily buttered toast which they affect, they inveigh against the eating of plain bread. In truth, the attempt to nourish the human intellect upon a diet which contains no metaphysics is about as hopeful as that of certain Eastern sages to nourish their bodies without destroying life. Everybody has heard the story of the pitiless microscopist, who ruined the peace of mind of one of these mild enthusiasts by showing him the animals moving in a drop of the water with which, in the innocency of his heart, he slaked his thirst; and the unsuspecting devotee of plain common sense may look for as unexpected a shock when the magnifier of severe logic reveals the germs, if not the full-grown shapes, of lively metaphysical postulates rampant amidst his most positive and matter-of-fact notions.

By way of escape from the metaphysical Will-o'-[290]the-wisps generated in the marshes of literature and theology, the serious student is sometimes bidden to betake himself to the solid ground of physical science. But the fish of immortal memory, who threw himself out of the frying-pan into the fire, was not more ill advised than the man who seeks sanctuary from philosophical persecution within the walls of the observatory or of the laboratory. It is said that "metaphysics" owe their name to the fact that, in Aristotle's works, questions of pure philosophy are dealt with immediately after those of physics. If so, the accident is happily symbolical of the essential relations of things; for metaphysical speculation follows as closely upon physical theory as black care upon the horseman.

One need but mention such fundamental, and indeed indispensable, conceptions of the natural philosopher as those of atoms and forces: or that of attraction considered as action at a distance; or that of potential energy; or the antinomies of a vacuum and a plenum; to call to mind the metaphysical

background of physics and chemistry; while, in the biological sciences, the case is still worse. What is an individual among the lower plants and animals? Are genera and species realities or abstractions? Is there such a thing as vital force, or does the name denote a mere relic of metaphysical fetichism? Is the doctrine of final causes legitimate or illegitimate? These [291] are a few of the metaphysical topics which are suggested by the most elementary study of biological facts. But, more than this, it may be truly said that the roots of every system of philosophy lie deep among the facts of physiology. No one can doubt that the organs and the functions of sensation are as much a part of the province of the physiologist, as are the organs and functions of motion, or those of digestion; and yet it is impossible to gain an acquaintance with even the rudiments of the physiology of sensation without being led straight to one of the most fundamental of all metaphysical problems. In fact, the sensory operations have been, from time immemorial, the battle-ground of philosophers.

I have more than once taken occasion to point out that we are indebted to Descartes, who happened to be a physiologist as well as a philosopher, for the first distinct enunciation of the essential elements of the true theory of sensation. In later times, it is not to the works of the philosophers, if Hartley and James Mill are excepted, but to those of the physiologists, that we must turn for an adequate account of the sensory process. Haller's luminous, though summary, account of sensation in his admirable "Primæ Lineæ," the first edition of which was printed in 1747, offers a striking contrast to the prolixity and confusion of thought which pervade Reid's [292] "Inquiry," of seventeen years' later date.[1] Even Sir William Hamilton, learned historian and acute critic as he was, not only failed to apprehend the philosophical bearing of long-established physiological truths; but, when he affirmed that there is no reason to deny that the mind feels at the finger points, and none to assert that the brain is the sole organ of thought, [2] he showed that he had not apprehended the significance of the revolution commenced, two hundred years before his time, by Descartes, and effectively followed up by Haller, Hartley, and Bonnet, in the middle of the last century.

In truth, the theory of sensation, except in one [293] point, is, at the present moment, very much where Hartley, led by a hint of Sir Isaac Newton's, left it, when, a hundred and twenty years since, the "Observations on Man: his Frame, his Duty, and his Expectations," was laid before the world. The whole matter is put in a nutshell in the following passages of this notable book.

"External objects impressed upon the senses occasion, first on the nerves on which they are impressed, and then on the brain, vibrations of the small and, as we may say, infinitesimal medullary particles.

"These vibrations are motions backwards and forwards of the small particles; of the same kind with the oscillations of pendulums and the tremblings of the particles of sounding bodies. They must be conceived to be exceedingly short and small, so as not to have the least efficacy to disturb or move the whole bodies of the nerves or brain."[3]

"The white medullary substance of the brain is also the immediate instrument by which ideas are presented to the mind; or, in other words, whatever changes are made in this substance, corresponding changes are made in our ideas; and *vice versa*."[4]

Hartley, like Haller, had no conception of the nature and functions of the grey matter of the brain. But, if for "white medullary substance," in the latter paragraph, we substitute "grey cellular substance," Hartley's propositions embody [294] the most probable conclusions which are to be drawn from the latest investigations of physiologists. In order to judge how completely this is the case, it will be well to study some simple case of sensation, and, following the example of Reid and of James Mill, we may begin with the sense of smell. Suppose that I become aware of a musky scent, to which the name of "muskiness" may be given. I call this an odour, and I class it along with the feelings of light, colours, sounds, tastes, and the like, among those phenomena which are known as sensations. To say that I am aware of this phenomenon, or that I have it, or that it exists, are simply different modes of affirming the same facts. If I am asked how I know that it exists, I can only reply that its existence and my knowledge of it are one and the same thing; in short, that my knowledge is immediate or intuitive, and, as such, is possessed of the highest conceivable degree of certainty.

The pure sensation of muskiness is almost sure to be followed by a mental state which is not a sensation, but a belief, that there is somewhere, close at hand, a something on which the existence of the sensation depends. It may be a musk-deer, or a musk-rat, or a musk-plant, or a grain of dry musk, or simply a scented handkerchief; but former experience leads us to believe that the sensation is due to the presence of one or other of these objects, and that it will vanish if the object [295] is removed. In other words, there arises a belief in an external cause of the muskiness, which, in common language, is termed an odorous body.

But the manner in which this belief is usually put into words is strangely misleading. If we are dealing with a musk-plant, for example, we do not confine ourselves to a simple statement of that which we believe, and say that the musk-plant is the cause of the sensation called muskiness; but we say that the plant has a musky smell, and we speak of the odour as a quality, or property, inherent in the plant. And the inevitable reaction of words upon thought has in this case become so complete, and has penetrated so deeply, that when an accurate statement of the case–namely, that muskiness, inasmuch as the term denotes nothing but a sensation, is a mental state, and has no existence except as a mental phenomenon–is first brought under the notice of common-sense folks, it is usually regarded by them as what they are pleased to call a mere metaphysical paradox and a patent example of useless subtlety. Yet the slightest reflection must suffice to convince any one possessed of sound reasoning faculties, that it is as absurd to suppose that muskiness is a quality inherent in one plant, as it would be to imagine that pain is a quality inherent in another, because we feel pain when a thorn pricks the finger.

Even the common-sense philosopher, *par excell* [296]*ence,* says of smell: "It appears to be a simple and original affection or feeling of the mind altogether inexplicable and unaccountable. It is indeed impossible that it can be in any body: it is a sensation, and a sensation can only be in a sentient thing."[5]

That which is true of muskiness is true of every other odour. Lavender-smell, clove-smell garlic-smell, are, like "muskiness," names of states of consciousness, and have no existence except as such. But, in ordinary language, we speak of all these odours as if they were independent entities residing in lavender,

cloves, and garlic; and it is not without a certain struggle that the false metaphysic of so-called common sense, thus ingrained in us, is expelled.

For the present purpose, it is unnecessary to inquire into the origin of our belief in external bodies, or into that of the notion of causation. Assuming the existence of an external world, there is no difficulty in obtaining experimental proof that, as a general rule, olfactory sensations, [297] are caused by odorous bodies; and we may pass *on* to the next step of the inquiry–namely, how the odorous body produces the effect attributed to it.

The first point to be noted here is another fact revealed by experience; that the appearance of the sensation is governed, not only by the presence of the odorous substance, but by the condition of a certain part of our corporeal structure, the nose. If the nostrils are closed, the presence of the odorous substance does not give rise to the sensation; while, when they are open, the sensation is intensified by the approximation of the odorous substance to them, and by snuffing up the adjacent air in such a manner as to draw it into the nose. On the other hand, looking at an odorous substance, or rubbing it on the skin, or holding it to the ear, does not awaken the sensation. Thus, it can be readily established by experiment that the perviousness of the nasal passages is, in some way, essential to the sensory function; in fact, that the organ of that function is lodged somewhere in the nasal passages. And, since odorous bodies give rise to their effects at considerable distances, the suggestion is obvious that something must pass from them into the sense organ. What is this "something," which plays the part of an intermediary between the odorous body and the sensory organ?

The oldest speculation about the matter dates [298] back to the Epicurean School and Democritus, and it is to be found fully stated in the fourth book of Lucretius. It comes to this: that the surfaces of bodies are constantly throwing off excessively attenuated films of their own substance: and that these films, reaching the mind, excite the appropriate sensations in it.

Aristotle did not admit the existence of any such material films, but conceived that it was the form of the substance, and not its matter, which affected sense, as a seal impresses wax, without losing anything in the process. While many, if not the majority, of the Schoolmen took up an intermediate position and supposed that a something, which was not exactly either material or immaterial, and which they called an "intentional species," effected the needful communication between the bodily cause of sensation and the mind.

But all these notions, whatever may be said for or against them in general, are fundamentally defective, by reason of an oversight which was inevitable, in the state of knowledge at the time in which they were promulgated. What the older philosophers did not know, and could not know, before the anatomist and the physiologist had done their work, is that, between the external object and that mind in which they supposed the sensation to inhere, there lies a physical obstacle. The sense organ is not a mere passage by which [299] the "tenuia simulacra rerum," or the "intentional species" cast off by objects, or the "forms of sensible things, pass straight to the mind; on the contrary, it stands as a firm and impervious barrier, through which no material particle of the world without can make its way to the world within.

Let us consider the olfactory sense organ more nearly. Each of the nostrils leads into a passage completely separated from the other by a partition, and these two passages place the nostrils in free communication with the back of the throat, so that they freely transmit the air passing to the lungs when the mouth is shut, as in ordinary breathing. The floor of each passage is flat, but its roof is a high arch, the crown of which is seated between the orbital cavities of the skull, which serve for the lodgment and protection of the eyes; and it therefore lies behind the apparent limits of that feature which, in ordinary language, is called the nose. From the side walls of the upper and back part of these arched chambers, certain delicate plates of bone project, and these, as well as a considerable part of the partition between the two chambers, are covered by a fine, soft, moist membrane. It is to this "Schneiderian," or olfactory, membrane that odorous bodies must obtain direct access, if they are to give rise to their appropriate sensations; and it is upon the relatively large surface, which [300] the olfactory membrane offers, that we must seek for the seat of the organ of the olfactory sense. The only essential part of that organ consists of a multitude of minute rod-like bodies, set perpendicularly to the surface of the membrane, and forming a part of the cellular coat, or epithelium, which covers the olfactory membrane, as the epidermis covers the skin. In the case of the olfactory sense, there can be no doubt that the Democritic hypothesis, at any rate for such odorous substances as musk, has a good foundation. Infinitesimal particles of musk fly off from the surface of the odorous body; these, becoming diffused through the air, are carried into the nasal passages, and thence into the olfactory chambers, where they come into contact with the filamentous extremities of the delicate olfactory epithelium.

But this is not all. The "mind" is not, so to speak, upon the other side of the epithelium. On the contrary, the inner ends of the olfactory cells are connected with nerve fibres, and these nerve fibres, passing into the cavity of the skull, at length end in a part of the brain, the olfactory sensorium. It is certain that the integrity of each, and the physical interconnection of all these three structures, the epithelium of the sensory organ, the nerve fibres, and the sensorium, are essential conditions of ordinary sensation. That is to say, the air in the olfactory chambers may be [301] charged with particles of musk; but, if either the epithelium, or the nerve fibres, or the sensorium is injured, or if they are physically disconnected from one another, sensation will not arise. Moreover, the epithelium may be said to be receptive, the nerve fibres transmissive, and the sensorium sensifacient. For, in the act of smelling, the particles of the odorous substance produce a molecular change (which Hartley was in all probability right in terming a vibration) in the epithelium, and this change being transmitted to the nerve fibres, passes along them with a measurable velocity, and, finally reaching the sensorium, is immediately followed by the sensation.

Thus, modern investigation supplies a representative of the Epicurean "simulacra" in the volatile particles of the musk; but it also gives us the stamp of the particles on the olfactory epithelium, without any transmission of matter, as the equivalent of the Aristotelian "form"; while, finally, the modes of motion of the molecules of the olfactory cells, of the nerve, and of the cerebral sensorium, which are Hartley's vibrations, may stand very well for a double of the "intentional species" of the Schoolmen. And this last remark is not intended merely to suggest a fanciful parallel; for, if the cause of the sensation is, as analogy suggests, to be sought in the mode of motion of the [302] object of sense, then it is quite possible that the particular mode of motion of the object is reproduced in the sensorium; exactly as the diaphragm of a telephone reproduces the mode of motion taken up at its receiving end. In other

words, the secondary "intentional species" may be, as the Schoolmen thought the primary one was, the last link between matter and mind.

None the less, however, does it remain true that no similarity exists, nor indeed is conceivable, between the cause of the sensation and the sensation. Attend as closely to the sensations of muskiness, or any other odour, as we will, no trace of extension, resistance, or motion is discernible in them. They have no attribute in common with those which we ascribe to matter; they are, in the strictest sense of the words, immaterial entities.

Thus, the most elementary study of sensation justifies Descartes' position, that we know more of mind than we do of body; that the immaterial world is a firmer reality than the material. For the sensation "muskiness" is known immediately. So long as it persists, it is a part of what we call our thinking selves, and its existence lies beyond the possibility of doubt. The knowledge of an objective or material cause of the sensation, on the other hand, is mediate; it is a belief as contradistinguished from an intuition; and it is a belief which, in any given instance of sensation, may, by possibility, be devoid of foundation. For odours, like other sensations, may arise from the occurrence of the appropriate molecular changes [303] in the nerve or in the sensorium, by the operation of a cause distinct from the affection of the sense organ by an odorous body. Such "subjective" sensations are as real existences as any others, and as distinctly suggest an external odorous object as their cause; but the belief thus generated is a delusion. And, if beliefs are properly termed "testimonies of consciousness," then undoubtedly the testimony of consciousness may be, and often is, untrustworthy.

Another very important consideration arises out of the facts as they are now known. That which, in the absence of a knowledge of the physiology of sensation, we call the cause of the smell, and term the odorous object, is only such, mediately, by reason of its emitting particles which give rise to a mode of motion in the sense organ, The sense organ, again, is only a mediate cause by reason of its producing a molecular change in the nerve fibre; while this last change is also only a mediate cause of sensation, depending, as it does, upon the change which it excites in the sensorium.

The sense organ, the nerve, and the sensorium, taken together, constitute the sensiferous apparatus. They make up the thickness of the wall between the mind, as represented by the sensation "muskiness," and the object, as represented by the particle of musk in contact with the olfactory epithelium.

[304] It will be observed that the sensiferous wall and the external world are of the same nature; whatever it is that constitutes them both is expressible in terms of matter and motion. Whatever changes take place in the sensiferous apparatus are continuous with, and similar to, those which take place in the external world.[6] But, with the sensorium, matter and motion come to an end; while phenomena of another order, or immaterial states of consciousness, make their appearance. How is the relation between the material and the immaterial phenomena to be conceived? This is [305] the metaphysical problem of problems, and the solutions which have been suggested have been made the corner-stones of systems of philosophy. Three mutually irreconcilable readings of the riddle have been offered.

The first is, that an immaterial substance of mind exists; and that it is affected by the mode of motion of the sensorium, in such a way as to give rise to the sensation,

The second is, that the sensation is a direct effect of the mode of motion of the sensorium, brought about without the intervention of any substance of mind.

The third is, that the sensation is, neither directly nor indirectly, an effect of the mode of motion of the sensorium, but that it has an independent cause. Properly speaking, therefore, it is not an effect of the motion of the sensorium, but a concomitant of it.

As none of these hypotheses is capable of even an approximation to demonstration, it is almost needless to remark that they have been severally held with tenacity and advocated with passion. I do not think it can be said of any of the three that it is inconceivable, or that it can be assumed on *a priori* grounds to be impossible.

Consider the first, for example; an immaterial substance is perfectly conceivable. In fact, it is obvious that, if we possessed no sensations but those of smell and hearing, we should be unable [306] to conceive a material substance. We might have a conception of time, but could have none of extension, or of resistance, or of motion. And without the three latter conceptions no idea of matter could be formed. Our whole knowledge would be limited to that of a shifting succession of immaterial phenomena. But if an immaterial substance may exist, it may have any conceivable properties; and sensation may be one of them. All these propositions may be affirmed with complete dialectic safety, inasmuch as they cannot possibly be disproved; but neither can a particle of demonstrative evidence be offered in favour of the existence of an immaterial substance.

As regards the second hypothesis, it certainly is not inconceivable, and therefore it may be true that sensation is the direct effect of certain kinds of bodily motion. It is just as easy to suppose this as to suppose, on the former hypothesis, that bodily motion affects an immaterial substance. But neither is it susceptible of proof.

And, as to the third hypothesis, since the logic of induction is in no case competent to prove that events apparently standing in the relation of cause and effect may not both be effects of a common cause–that also is as safe from refutation, if as incapable of demonstration, as the other two.

In my own opinion, neither of these speculations can be regarded seriously as anything but a more [307] or less convenient working hypothesis. But, if I must choose among them, I take the "law of parcimony" [sic] for my guide, and select the simplest–namely, that the sensation is the direct effect of the mode of motion of the sensorium. It may justly be said that this is not the slightest explanation of sensation; but then am I really any the wiser, if I say that a sensation is an activity (of which I know nothing) of a substance of mind (of which also I know nothing)? Or, if I say that the Deity causes the sensation to arise in my mind immediately after he has caused the particles of the sensorium to move in a certain way, is anything gained? In truth, a sensation, as we have already seen, is an intuition–a part of

immediate knowledge. As such, it is an ultimate fact and inexplicable; and all that we can hope to find out about it, and that indeed is worth finding out, is its relation to other natural facts. That relation appears to me to be sufficiently expressed, for all practical purposes, by saying that sensation is the invariable consequent of certain changes in the sensorium–or, in other words, that, so far as we know the change in the sensorium is the cause of the sensation.

I permit myself to imagine that the untutored, if noble, savage of "common sense" who has been misled into reading thus far, by the hope of getting positive solid information about sensation, giving way to not unnatural irritation, may here inter[308]pellate: "The upshot of all this long disquisition is that we are profoundly ignorant. We knew that to begin with, and you have merely furnished another example of the emptiness and uselessness of metaphysics." But I venture to reply, Pardon me, you were ignorant, but you did not know it. On the contrary, you thought you knew a great deal, and were quite satisfied with the particularly absurd metaphysical notions which you were pleased to call the teachings of common sense. You thought that your sensations were properties of external things, and had an existence outside of yourself. You thought that you knew more about material than you do about immaterial existences. And if, as a wise man has assured us, the knowledge of what we don't know is the next best thing to the knowledge of what we do know, this brief excursion into the province of philosophy has been highly profitable.

Of all the dangerous mental habits, that which schoolboys call "cocksureness" is probably the most perilous; and the inestimable value of metaphysical discipline is that it furnishes an effectual counterpoise to this evil proclivity. Whoso has mastered the elements of philosophy knows that the attribute of unquestionable certainty appertains only to the existence of a state of consciousness so long as it exists; all other beliefs are mere probabilities of a higher or lower order. Sound metaphysic is an amulet which [309] renders its possessor proof alike against the poison of superstition and the counter-poison of shallow negation; by showing that the affirmations of the former and the denials of the latter alike deal with matters about which, for lack of evidence, nothing can be either affirmed or denied.

I have dwelt at length upon the nature and origin of our sensations of smell, on account of the comparative freedom of the olfactory sense from the complications which are met with in most of the other senses.

Sensations of taste, however, are generated in almost as simple a fashion as those of smell. In this case, the sense organ is the epithelium which covers the tongue and the palate: and which sometimes, becoming modified, gives rise to peculiar organs termed "gustatory bulbs," in which the epithelial cells elongate and assume a somewhat rodlike form. Nerve fibres connect the sensory organ with the sensorium, and tastes or flavours are states of consciousness caused by the change of molecular state of the latter. In the case of the sense of touch there is often no sense organ distinct from the general epidermis. But many fishes and amphibia exhibit local modifications of the epidermic cells which are, sometimes, extraordinarily like the gustatory bulbs; more commonly, both in lower and higher animals, the effect of the contact of external bodies is intensified [310] by the development of hair-like filaments, or of true hairs, the bases of which are in immediate relation with the ends of the sensory nerves. Every one must have noticed the extreme delicacy of the sensations produced by the contact of bodies with the

ends of the hairs of the head, and the "whiskers" of cats owe their functional importance to the abundant supply of nerves to the follicles in which their bases are lodged. What part, if any, the so-called "tactile corpuscles," "end bulbs," and "Pacinian bodies," play in the mechanism of touch is unknown. If they are sense organs, they are exceptional in character, in so far as they do not appear to be modifications of the epidermis. Nothing is known respecting the organs of those sensations of resistance which are grouped under the head of the muscular sense; nor of the sensations of warmth and cold; nor of that very singular sensation which we call tickling.

In the case of heat and cold, the organism not only becomes affected by external bodies, far more remote than those which affect the sense of smell; but the Democritic hypothesis is obviously no longer permissible. When the direct rays of the sun fall upon the skin, the sensation of heat is certainly not caused by "attenuated films" thrown off from that luminary, but is due to a mode of motion which is transmitted to us. In Aristotelian phrase, it is the form without the matter of the [311] sun which stamps the sense organ; and this, translated into modern language, means nearly the same thing as Hartley's vibrations. Thus we are prepared for what happens in the case of the auditory and the visual senses. For neither the ear, nor the eye, receives anything but the impulses or vibrations originated by sonorous or luminous bodies. Nevertheless, the receptive apparatus still consists of specially modified epithelial cells. In the labyrinth, or essential part of the ear of the higher animals, the free ends of these cells terminate in excessively delicate hairlike filaments; while, in the lower forms of auditory organ, its free surface is beset with delicate hairs like those of the surface of the body, and the transmissive nerves are connected with the bases of these hairs. Thus there is an insensible gradation in the forms of the receptive apparatus, from the organ of touch, on the one hand, to those of taste and smell; and, on the other hand, to that of hearing.

Even in the case of the most refined of all the sense organs, that of vision, the receptive apparatus departs but little from the general type. The only essential constituent of the visual sense organ is the retina, which forms so small a part of the eyes of the higher animals; and the simplest eyes are nothing but portions of the integument, in which the cells of the epidermis have become converted into glassy rod-like retinal [312] corpuscles. The outer ends of these are turned towards the light; their sides are more or less extensively coated with a dark pigment, and their inner ends are connected with the transmissive nerve fibres. The light, impinging on these visual rods, produces a change in them which is communicated to the nerve fibres, and, being transmitted to the sensorium, gives rise to the sensation–if indeed all animals which possess eyes are endowed with what we understand as sensation.

In the higher animals, a complicated apparatus of lenses, arranged on the principle of a camera obscura, serves at once to concentrate and to individualise the pencils of light proceeding from external bodies. But the essential part of the organ of vision is still a layer of cells, which have the form of rods with truncated or conical ends. By what seems a strange anomaly, however, the glassy ends of these are turned not towards, but away from, the light: and the latter has to traverse the layer of nervous tissues with which their outer ends are connected, before it can affect them. Moreover, the rods and cones of the vertebrate retina are so deeply seated, and in many respects so peculiar in character, that it appears impossible, at first sight, that they can have anything to do with that epidermis of which gustatory and tactile and, at any rate, the lower forms of auditory and visual, organs are obvious modifications.

[313] Whatever be the apparent diversities among the sensiferous apparatuses, however, they share certain common characters. Each consists of a receptive, a transmissive, and a sensificatory portion. The essential part of the first is an epithelium, of the second, nerve fibres, of the third, a part of the brain; the sensation is always the consequence of the mode of motion excited in the receptive, and sent along the transmissive, to the sensificatory part of the sensiferous apparatus. And, in all the senses, there is no likeness whatever between the object of sense, which is matter in motion, and the sensation, which is an immaterial phenomenon.

On the hypothesis which appears to me to be the most convenient, sensation is a product of the sensiferous apparatus caused by certain modes of motion which are set up in it by impulses from without. The sensiferous apparatuses are, as it were, factories, all of which at the one end receive raw materials of a similar kind–namely, modes of motion–while, at the other, each turns out a special product, the feeling which constitutes the kind of sensation characteristic of it.

Or, to make use of a closer comparison, each sensiferous apparatus is comparable to a musical-box wound up; with as many tunes as there are separate sensations. The object of a simple sensation is the agent which presses down the stop [314] of one of these tunes, and the more feeble the agent, the more delicate must be the mobility of the stop.[7]

But, if this be true, if the recipient part of the sensiferous apparatus is in all cases, merely a mechanism affected by coarser or finer kinds of material motion, we might expect to find that all sense organs are fundamentally alike, and result from the modification of the same morphological elements. And this is exactly what does result from all recent histological and embryological investigations.

It has been seen that the receptive part of the olfactory apparatus is a slightly modified epithelium, which lines an olfactory chamber deeply seated between the orbits in adult human beings But, if we trace back the nasal chambers to their origin in the embryo, we find, that, to begin with, they are mere depressions of the skin of the forepart of the head, lined by a continuation of the general epidermis. These depressions become pits, and the pits, by the growth of the adjacent parts, gradually acquire the position which they finally occupy. The olfactory organ, therefore, is a specially modified part of the general integument.

[315] The human ear would seem to present greater difficulties. For the essential part of the sense organ, in this case, is the membranous labyrinth, a bag of complicated form, which lies buried in the depths of the floor of the skull, and is surrounded by dense and solid bone. Here, however, recourse to the study of development readily unravels the mystery. Shortly after the time when the olfactory organ appears, as a depression of the skin on the side of the fore part of the head, the auditory organ appears as a similar depression on the side of its back part. The depression, rapidly deepening, becomes a small pouch; and then, the communication with the exterior becoming shut off, the pouch is converted into a closed bag, the epithelial lining of which is a part of the general epidermis segregated from the rest. The adjacent tissues, changing first into cartilage and then into bone, enclose the auditory sac in a strong case, in

which it undergoes its further metamorphoses; while the drum, the ear bones, and the external ear, are superadded by no less extraordinary modifications of the adjacent parts. Still more marvellous is the history of the development of the organ of vision. In the place of the eye, as in that of the nose and that of the ear, the young embryo presents a depression of the general integument; but, in man and the higher animals, this does not give rise to the [316] proper sensory organ, but only to part of the accessory structures concerned in vision. In fact, the depression, deepening and becoming converted into a shut sac, produces only the cornea, the aqueous humour, and the crystalline lens of the perfect eye.

The retina is added to this by the outgrowth of the wall of a portion of the brain into a sort of bag, or sac, with a narrow neck, the convex bottom of which is turned outwards, or towards the crystalline lens. As the development of the eye proceeds, the convex bottom of the bag becomes pushed in, so that it gradually obliterates the cavity of the sac, the previously convex wall of which becomes deeply concave. The sac of the brain is now like a double nightcap ready for the head, but the place which the head would occupy is taken by the vitreous humour, while the layer of nightcap next it becomes the retina. The cells of this layer which lie farthest from the vitreous humour, or, in other words, bound the original cavity of the sac, are metamorphosed into the rods and cones. Suppose now that the sac of the brain could be brought back to its original form; then the rods and cones would form part of the lining of a side pouch of the brain. But one of the most wonderful revelations of embryology is the proof of the fact that the brain itself is, at its first beginning, merely an infolding of the [317] epidermic layer of the general integument. Hence it follows that the rods and cones of the vertebrate eye are modified epidermic cells, as much as the crystalline cones of the insect or crustacean eye are; and that the inversion of the position of the former in relation to light arises simply from the roundabout way in which the vertebrate retina is developed.

Thus all the higher sense organs start from one foundation, and the receptive epithelium of the eye, or of the ear, is as much modified epidermis as is that of the nose. The structural unity of the sense organs is the morphological parallel to their identity of physiological function, which, as we have seen, is to be impressed by certain modes of motion; and they are fine or coarse, in proportion to the delicacy or the strength of the impulses by which they are to be affected.

In ultimate analysis, then, it appears that a sensation is the equivalent in terms of consciousness for a mode of motion of the matter of the sensorium. But, if inquiry is pushed a stage farther, and the question is asked, What then do we know about matter and motion? there is but one reply possible. All that we know about motion is that it is a name for certain changes in the relations of our visual, tactile, and muscular sensations; and [318] all that we know about matter is that it is the hypothetical substance of physical phenomena–the assumption of the existence of which is as pure a piece of metaphysical speculation as is that of the existence of the substance of mind.

Our sensations, our pleasures, our pains, and the relations of these, make up the sum total of the elements of positive, unquestionable knowledge. We call a large section of these sensations and their relations matter and motion; the rest we term mind and thinking; and experience shows that there is a certain constant order of succession between some of the former and some of the latter.

This is all that just metaphysical criticism leaves of the idols set up by the spurious metaphysics of vulgar common sense. It is consistent either with pure Materialism, or with pure Idealism, but it is neither. For the Idealist, not content with declaring the truth that our knowledge is limited to facts of consciousness, affirms the wholly unprovable proposition that nothing exists beyond these and the substance of mind. And, on the other hand, the Materialist, holding by the truth that, for anything that appears to the contrary material phenomena are the causes of mental phenomena, asserts his unprovable dogma, that material phenomena and the substance of matter are the sole primary existences.

[319] Strike out the propositions about which neither controversialist does or can know anything, and there is nothing left for them to quarrel about. Make a desert of the Unknowable, and the divine Astræa of philosophic peace will commence her blessed reign.

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[1] In justice to Reid, however, it should be stated that the chapters on sensation in the *Essays on the Intellectual Powers* (1785) exhibit a great improvement. He is, in fact, in advance of his commentator, as the note to Essay 11. chap. ii. p. 248 of Hamilton's edition shows.

[2] Haller, amplifying Descartes, writes in the *Primæ Lineæ*, CCCLXVI.–"Non est adeo obscurum sensum omnem oriri ab objecti sensibilis impressione in nervum quemcumque corporis humani, et eamdem per cum nervum ad cerebrum pervenientem tunc demum representari animæ, quando cerebrum adtigit. Ut etiam hoc falsum sit animam inproximo per sensoria nerverumque ramos sentire." . . . DLVII.–"Dum ergo sentimus quinque diversissima entia conjunguntur: corpus quod sentimus: organi sensorii adfectio ab eo corpore: cerebri adfectio a sensorii percussione nata: in anima nata mutatio: animæ denique conscientia et sensationis adperceptio." Nevertheless, Sir Wiiliam Hamilton gravely informs his hearers:–"We have no more right to deny that the mind feels at the finger points, as consclousness assures us, than to assert that it thinks exclusively in the brain."–*Lecture on Metaphysics and Logic*, ii. p. 128. "We have no reason whatever to doubt the report of consciousness, that we actually perceive at the external point of sensation, and that we perceive the material reality."–*Ibid.* p. 129.

[3] *Observations on Man*, vol. i. p.11.

[4] *Ibid.* p. 8. The speculations of Bonnet are remarkably similar to those of Hartley; and they appear to have originated independently, though the *Essai de Psychologie* (1754) is of five years' later date than the *Observations on Man* (1749).

[5] "*An Inquiry into the Human Mind on the Principles of Common Sense*, chap. ii. § 2. Reid affirms that "it is genius, and not the want of it, that adulterates philosophy, and fills it with error and false theory;" and no doubt his own lucubrations are free from the smallest taint of the impurity to which he objects. But, for want of something more than that sort of "common sense," which is very common and a little dull, the contemner of genius did not notice that the admission here made knocks so big a hole in the bottom of "common sense philosophy," that nothing can save it from foundering in the dreaded abyss of Idealism.

[6] The following diagrammatic scheme may help to elucidate the theory of sensation:–

Mediate Knowledge				Immediate Knowledge
	Sensiferous Apparatus			
Objects of Sense	Receptive (Sense organ)	Transmissive (Nerve)	Sensificatory (Sensorium)	Sensations and other States of Consciousness
Hypothetical Substance of Matter				Hypothetical Substance of Mind
Physical World				Mental World
Not self				Self
Non-Ego or Object				Ego or Subject

Immediate knowledge is confined to states of consciousness, or, in other words, to the phenomena of mind. Knowledge of the physical world, or of one's own body and of objects external to it, is a system of beliefs or judgments based on the sensations. The term "self" is applied not only to the series of mental phenomena which constitute the ego, but to the fragment of the physical world which is their constant concomitant. The corporeal self, therefore, is part of the non-ego; and it is objective in relation to the ego or subject.

[7] "Chaque fibre est une espèce de touche ou de marteau destine à rendre un certain ton."–Bonnet, *Essai de Psychologie,* chap. iv.

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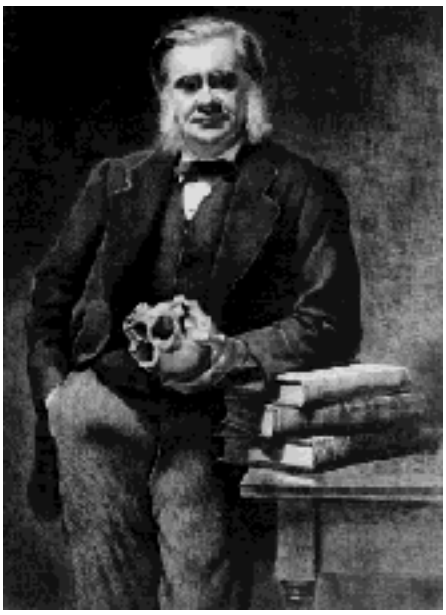

Preface and Table of Contents to Volume VI, *Hume,* of Huxley's *Collected Essays.*

Previous article: Bishop Berkeley on the Metaphysics of Sensation [1871], pages 243-287.

Preface and Table of Contents to the next volume, Volume VII, of Huxley's *Collected Essays.*

C. Blinderman & D. Joyce
Clark University

[xv] Man's Place in Nature

Advertisement to the Reader

The greater part of the substance of the following Essays has already been published in the form of Oral Discourses, addressed to widely different audiences during the past three years.

Upon the subject of the second Essay, I delivered six Lectures to the Working Men in 1860, and two, to the members of the Philosophical Institution of Edinburgh in 1862. The readiness with which my audience followed my arguments, on these occasions, encourages me to hope that I have not committed the error, into which working men of science so readily fall, of obscuring my meaning by unnecessary technicalities: while, the length of the period during which the subject, under its various aspects, has been present to my mind, may suffice to satisfy the Reader that, my conclusions, be they right or be they wrong, have not been formed hastily or enunciated crudely.

London: *January*, 1863.

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I

On the Natural History of the Man-Like Apes (1863)

Collected Essays VII

[1] Ancient traditions, when tested by the severe processes of modern investigation, commonly enough fade away into mere dreams: but it is singular how often the dream turns out to have been a half-waking one, presaging a reality. Ovid foreshadowed the discoveries of the geologist: the Atlantis was an imagination, but Columbus found a western world: and though the quaint forms of Centaurs and Satyrs have an existence only in the realms of art, creatures approaching man more nearly than they in essential structure, and yet as thoroughly brutal as the goat's or horse's half of the mythical compound, are now not only known, but notorious.

I have not met with any notice of one of these Man-Like Apes of earlier date than that contained in Pigafetta's "Description of the [2] kingdom of Congo,"[1] drawn up from the notes of a Portuguese sailor, Eduardo Lopez, and published in 1598.

Fig. 1–Simiæ magnatum deliciæ.–De Bry, 1598.

The tenth chapter of this work is entitled "De Animalibus quæ in hac provincia reperiuntur," and contains a brief passage to the effect that "in the Songan country, on the banks of the Zaire, there are multitudes of apes, which [3] afford great delight to the nobles by imitating human gestures." As this might apply to almost any kind of apes, I should have thought little of it, had not the brothers De Bry, whose engravings illustrate the work, thought fit, in their eleventh "Argumentum," to figure two of these "Simiæ magnatum deliciæ." So much of the plate as contains these apes is faithfully copied in the woodcut (Fig. 1), and it will be observed that they are tail-less long-armed, and large-eared; and about the size of Chimpanzees. It may be that these apes are as much figments of the imagination of the ingenious brothers as the winged, two-legged, crocodile-headed dragon which adorns the same plate; or, on the other hand, it may be that the artists have constructed their drawings from some essentially faithful description of a Gorilla or a Chimpanzee. And, in either case, though these figures are worth a passing notice, the oldest trustworthy and definite accounts of any animal of this kind date from the 17th century, and are due to an Englishman.

The first edition of that most amusing old book, "Purchas his Pilgrimage," was published in 1613, and therein are to be found many references to the statements of one whom Purchas terms "Andrew Battell (my neere neighbour, dwelling at Leigh in Essex) who served under Manuel Silvera Perera, Governor under the King of Spaine, at his city of Saint Paul, and with him [4] went farre into the countrey of Angola"; and again, "my friend, Andrew Battle, who lived in the kingdom of Congo many yeares," and who, "upon some quarell betwixt the Portugals (among whom he was a sergeant of a band) and him, lived eight or nine moneths in the woodes." From this weather-beaten old soldier, Purchas was amazed to hear "of a kinde of Great Apes, if they might so bee termed, of the height of a man, but twice as bigge in feature of their limmes, with strength proportionable, hairie all over, otherwise altogether like men and women in their whole bodily shape.[2] They lived on such wilde fruits as the trees and woods yielded, and in the night time lodged on the trees."

This extract is, however, less detailed and clear in its statements than a passage in the third chapter of the second part of another work–"Purchas his Pilgrimes," published in 1625, by the same author–which has

been often, though hardly ever quite rightly, cited. The chapter is entitled, "The strange adventures of Andrew Battell, of Leigh in Essex, sent by the Portugals prisoner to Angola, who lived there and in the adioining regions neere eighteene yeeres." And the sixth section of this chapter is headed–" Of the Provinces of Bongo, Calongo, Mayombe, Manikesocke, Motimbas: of the Ape Monster Pongo, [5] their hunting: Idolatries; and divers other observations."

"This province (Calongo) toward the east bordereth upon Bongo, and toward the north upon Mayombe, which is nineteen leagues from Longo along the coast.

"This province of Mayombe is all woods and groves, so over-growne that a man may travaile twentie days in the shadow without any sunne or heat. Here is no kind of corne nor graine, so that the people liveth onely upon plantanes and roots of sundrie sorts, very good; and nuts; nor any kinde of tame cattell, nor hens.

"But they have great store of elephants' flesh, which they greatly esteeme, and many kinds of wild beasts; and great store of fish. Here is a great sandy bay, two leagues to the northward of Cape Negro,[3] which is the port of Mayombe. Sometimes the Portugals lade logwood in this bay. Here is a great river, called Banna: in the winter it hath no barre, because the generall winds cause a great sea. But when the sunne hath his south declination, then a boat may goe in; for then it is smooth because of the raine. This river is very great, and hath many ilands and people dwelling in them. The woods are so covered with baboones, monkies, apes and parrots, that it will feare any man to travaile in them alone. Here are also two kinds of monsters, which are common in these woods, and very dangerous.

"The greatest of these two monsters is called Pongo in their language, and the lesser is called Engeco. This Pongo is in all proportion like a man; but that he is more like a giant in stature than a man; for he is very tall, and hath a man's face, hollow-eyed, with long haire upon his browes. His face and eares are without haire, and his hands also. His bodie is full of haire, but not very thicke; and it is of a dunnish colour.

"He differeth not from a man but in his legs; for they have [6] no calfe. Hee goeth alwaies upon his legs, and carrieth his hands clasped in the nape of his necke when he goeth upon the ground. They sleepe in the trees, and build shelters for the raine. They feed upon fruit that they find in the woods, and upon nuts, for they eate no kind of flesh. They cannot speake, and have no understanding more than a beast. The people of the countrie, when they travaile in the woods make fires where they sleepe in the night; and in the morning when they are gone, the Pongoes will come and sit about the fire till it goeth out; for they have no understanding to lay the wood together. They goe many together and kill many negroes that travaile in the woods. Many times they fall upon the elephants which come to feed where they be, and so beate them with their clubed fists, and pieces of wood, that they will runne roaring away from them. Those Pongoes are never taken alive because they are so strong, that ten men cannot hold one of them; but yet they take many of their young ones with poisoned arrowes.

"The young Pongo hangeth on his mother's belly with his hands fast clasped about her, so that when the countrie people kill any of the females they take the young one, which hangeth fast upon his mother.

"When they die among themselves, they cover the dead with great heaps of boughs and wood, which is commonly found in the forest."[4]

It does not appear difficult to identify the exact region of which Battell speaks. Longo is [7] doubtless the name of the place usually spelled Loango on our maps. Mayombe still lies some nineteen leagues northward from Loango, along the coast; and Cilongo or Kilonga, Manikesocke, and Motimbas are yet registered by geographers. The Cape Negro of Battell, however, cannot be the modern Cape Negro in 16° S., since Loango itself is in 4° S. latitude. On the other hand, the "great river called Banna" corresponds very well with the "Camma" and "Fernand Vas," of modern geographers, which form a great delta on this part of the African coast.

Now this "Camma" country is situated about a degree and a-half south of the Equator, while a few miles to the north of the line lies the Gaboon, and a degree or so north of that, the Money River–both well known to modern naturalists as localities where the largest of man-like Apes has been obtained. Moreover, at the present day, the word Engeco, or N'schego, is applied by the natives of these regions to the smaller of the two great Apes which inhabit them; so that there can be no rational doubt that Andrew Battell spoke of that which he knew of his own knowledge, or, at any rate, by immediate report from the natives of Western Africa. The "Engeco," however, is that "other monster" whose nature Battell "forgot to relate," while the name "Pongo"–applied to the animal whose characters and habits are so fully and carefully described–seems to [8] have died out, at least in its primitive form and signification. Indeed, there is evidence that not only in Battell's time, but up to a very recent date, it was used in a totally different sense from that in which he employs it.

For example, the second chapter of Purchas' work, which I have just quoted, contains "A Description and Historicall Declaration of the Golden Kingdom of Guinea, &c. &c. Translated from the Dutch, and compared also with the Latin," wherein it is stated (p. 986) that–

"The River Gaboon lyeth about fifteen miles northward from Rio de Angra, and eight miles northward from Cape de Lope Gonsalves (Cape Lopez), and is right under the Equinoctial line, about fifteene miles from St. Thomas, and is a great land, well and easily to be knowne. At the mouth of the river there lieth a sand, three or foure fathoms deepe whereon it beateth mightily with the streame which runneth out of the river into the sea. This river, in the mouth thereof, is at least four miles broad; but when you are about the Iland called *Pongo,* it is not above two miles broad.... On both sides the river there standeth many trees..... The Iland called *Pongo,* which hath a monstrous high hill."

The French naval officers, whose letters are appended to the late M. Isidore Geoff. Saint Hilaire's excellent essay on the Gorilla,[5] note in similar terms the width of the Gaboon, the trees that line its banks down to the water's edge, and the strong current that sets out of it. They describe two islands in its estuary;–one low, [9] called Perroquet; the other high, presenting three conical hills, called Coniquet; and one of them, M. Franquet, expressly states that, formerly, the Chief of Coniquet was called *Meni-Pongo,* meaning thereby Lord of *Pongo;* and that the *N'Pongues*(as, in agreement with Dr. Savage, he affirms the natives call themselves) term the estuary of the Gaboon itself *N'Pongo.*

It is so easy, in dealing with savages, to misunderstand their applications of words to things, that one is at first inclined to suspect Battell of having confounded the name of this region, where his "greater monster" still abounds, with the name of the animal itself. But he is so right about other matters

(including the name of the "lesser monster") that one is loth to suspect the old traveller of error; and, on the other hand, we shall find that a voyager of a hundred years' later date speaks of the name "Boggoe," as applied to a great Ape, by the inhabitants of quite another part of Africa–Sierra Leone.

But I must leave this question to be settled by philologers and travellers; and I should hardly have dwelt so long upon it except for the curious part played by this word *'Pongo'* in the later history of the man-like Apes.

The generation which succeeded Battell saw the first of the man-like Apes which was ever brought to Europe, or, at any rate, whose visit found a historian. In the third book of Tulpius' [10] "Observationes Medicæ," published in 1641, the 56th chapter or section is devoted to what he calls *Satyrus indicus*, "called by the Indians Orang-autang or Man-of-the-Woods, and by the Africans Quoias Morrou." He gives a very good figure, evidently from the life, of the specimen of this animal, "nostra memoria ex Angolâ delatum," presented to Frederick Henry Prince of Orange.

Fig. 2.–The Orang of Tulpius, 1641.

Tulpius says it was as big as a child of three years old, and as stout as one of six years: and that its [11] back was covered with black hair. It is plainly a young Chimpanzee.

In the meanwhile, the existence of other, Asiatic, man-like Apes became known, but at first in a very mythical fashion. Thus Bontius (1658) gives an altogether fabulous and ridiculous account and figure of an animal which he calls "Orang-outang"; and though he says "vidi Ego cujus effigiem hic exhibeo," the said effigies (see Fig. 6 for Hoppius' copy of it) is nothing but a very hairy woman of rather comely aspect, and with proportions and feet wholly human. The judicious English anatomist, Tyson, was justified in saying of this description by Bontius, "I confess I do mistrust the whole representation."

It is to the last-mentioned writer, and his coadjutor Cowper, that we owe the first account of a man-like ape which has any pretensions to scientific accuracy and completeness. The treatise entitled, "*Orang-*

outang, sive Homo Sylvestris; or the Anatomy of a Pygmie compared with that of a *Monkey*, an *Ape*, and a *Man*," published by the Royal Society in 1699, is, indeed, a work of remarkable merit, and has, in some respects, served as a model to subsequent inquirers. This "Pygmie," Tyson tells us "was brought from Angola, in Africa; but was first taken a great deal higher up the country"; its hair "was of a coal-black colour and strait," and "when it went as a quadruped on all four, 'twas [12] awkwardly; not placing the palm of the hand flat to the ground, but it walks upon its knuckles, as I observed it to do when weak and had not strength enough to support its body."–"From the top of the head to the heel of the foot, in a strait line, it measured twenty-six inches."

Fig. 3–The "Pygmie" reduced from Tyson's figure 1, 1699.

These characters, even without Tyson's good figure (Figs. 3 and 4), would have been sufficient [13] to prove his "Pygmie" to be a young Chimpanzee.

Fig. 4–The "Pygmie" reduced from Tyson's figure 2, 1699.

But the opportunity of examining the skeleton of the very animal Tyson anatomised having most unexpectedly presented itself to me, I am able to bear independent testimony to its being a veritable

Troglodytes niger,[6] though still very young. [14] Although fully appreciating the resemblances between his Pygmie and Man, Tyson by no means overlooked the differences between the two, and he concludes his memoir by summing up first, the points in which "the Ourang-outang or Pygmie more resembled a Man than Apes and Monkeys do," under forty-seven distinct heads; and then giving, in thirty-four similar brief paragraphs, the respects in which "the Ourang-outang or Pygmie differ'd from a man and resembled more the Ape and Monkey kind."

After a careful survey of the literature of the subject extant in his time, our author arrives at the conclusion that his "Pygmie" is identical neither with the Orangs of Tulpius and Bontius, nor with the Quoias Morrou of Dapper (or rather of Tulpius), the Barris of d'Arcos, nor with the Pongo of Battell; but that it is a species of ape probably identical with the Pygmies of the Ancients, and, says Tyson, though it "does so much resemble *a Man* in many of its parts, more than any of the ape kind, or any other *animal* in the world, that I know of: yet by no means do I look upon it as the product of a *mixt* generation–[15] 'tis a *Brute-Animal sui generis*, and a particular *species of Ape*."

The name of "Chimpanzee," by which one of the African Apes is now so well known, appears to have come into use in the first half of the eighteenth century, but the only important addition made, in that period, to our acquaintance with the man-like apes of Africa is contained in "A New Voyage to Guinea," by William Smith, which bears the date 1744.

In describing the animals of Sierra Leone, p. 51, this writer says:–

"I shall next describe a strange sort of animal, called by the white men in this country Mandrill,[7] but why it is so called I know not, nor did I ever hear the name before, neither can those who call them so tell, except it be for their near resemblance of a human creature, though nothing at all like an Ape. Their bodies, when full grown, are as big in circumference as a middle-sized man's–their legs much shorter, and their feet larger; their arms and hands in proportion. The head is monstrously big, and the face broad and flat, without any other hair but the eyebrows; the nose very small, the mouth wide, [16] and the lips thin. The face, which is covered by a white skin, is monstrously ugly, being all over wrinkled as with old age; the teeth broad and yellow; the hands have no more hair than the face, but the same white skin, though all the rest of the body is covered with long black hair, like a bear. They never go upon all-fours, like apes; but cry, when vexed or teased, just like children....."

Fig. 5. Facsimile of William Smith's figure of the "Mandrill," 1744.

"When I was at Sherbro, one Mr. Cummerbus, whom I shall have occasion hereafter to mention, made me a present of one of these strange animals, which are called by the natives Boggoe: it was a she-cub, of six months' age, but even then larger than a Baboon. I gave it in charge to one of the slaves, who knew how to feed and nurse it, being a very tender sort of animal; but whenever I went off the deck the sailors began to teaze it–some loved to see its tears and hear it cry; others [17] hated its snotty nose; one who hurt it, being checked by the negro that took care of it, told the slave he was very fond of his country-woman, and asked him if he should not like her for a wife? To which the slave very readily replied, 'No, this no my wife; this a white woman–this fit wife for you.' This unlucky wit of the negro's, I fancy, hastened its death, for next morning it was found dead under the windlass."

William Smith's "Mandrill," or "Boggoe," as his description and figure testify, was, without doubt, a Chimpanzee.

Linnæus knew nothing, of his own observation, of the man-like Apes of either Africa or Asia, but a dissertation by his pupil Hoppius in the "Amœnitates Academicæ" (VI. "Anthropomorpha") may be regarded as embodying his views respecting these animals.

The dissertation is illustrated by a plate, of which the accompanying woodcut, Fig, 6, is a reduced copy, The figures are entitled (from left to right 1. *Troglodyta Bontii;* 2. *Lucifer Aldrovandi;* 3. *Satyrus Tulpii;* 4. *Pygmæus Edwardi.* The first is a bad copy of Bontius' fictitious "Ourang-outang," in whose existence, however, Linnæus appears to have fully believed; for in the standard edition of the "Systema Naturæ," it is enumerated as a second species of Homo; "H. nocturnus." *Lucifer Aldrovandi* is a copy of a figure in Aldrovandus, "De Quadrupedibus digitatis viviparis," Lib. 2, p. 249 (1645) entitled "Cercopithecus formæ raræ *Barbilius* vocatus et originem a china ducebat." Hoppius [18] is of opinion that this may be one of that cat-tailed people, of whom Nicolaus Köping affirms that they eat a boat's crew, "gubernator navis" and all! In the "Systema Naturæ" Linnaeus calls it in a note, *Homo caudatus,*and seems inclined to regard it as a third species of man. According to Temminck, *Satyrus Tulpii* is a copy of the figure of a Chimpanzee published by Scotin in 1738, which I have not seen. It is the *Satyrus indicus* of the "Systema Naturæ," and is regarded by Linnæus as possibly a distinct species from *Satyrus sylvestris.* The last, named *Pygmæus Edwardi,* is copied from the figure of a young "Man of the Woods," or true Orang-Utan, given in Edwards' "Gleanings of Natural History" (1758).

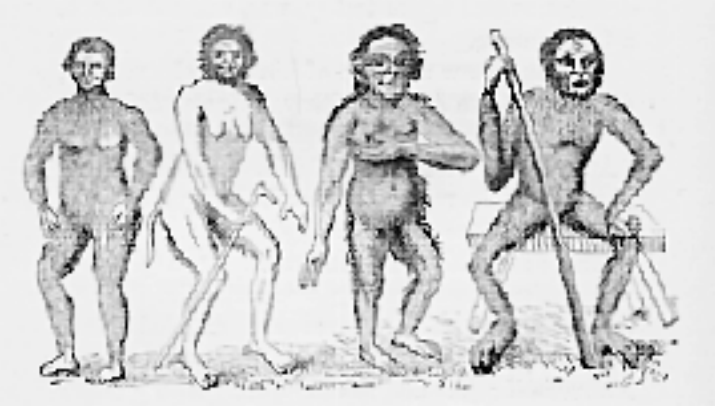

Fig. 6.–The Anthropomorpha of Linnæus.

[19] Buffon was more fortunate than his great rival. Not only had he the rare opportunity of examining a young Chimpanzee in the living state, but he became possessed of an adult Asiatic manlike Ape–the first and the last adult specimen of any of these animals brought to Europe for many years. With the valuable assistance of Daubenton, Buffon gave an excellent description of this creature, which, from its singular proportions, he termed the long-armed Ape, or Gibbon. It is the modern *Hylobates lar*.

Thus when, in 1766, Buffon wrote the fourteenth volume of his great work, he was personally familiar with the young of one kind of African man-like Ape, and with the adult of an Asiatic species–while the Orang-Utan and the Mandrill of Smith were known to him by report. Furthermore, the Abbé Prevost had translated a good deal of Purchas' "Pilgrims" into French, in his "Histoire générale des Voyages" (1748), and there Buffon found a version of Andrew Battell's account of the Pongo and the Engeco. All these data Buffon attempts to weld together into harmony in this chapter entitled "Les Orang-outangs ou le Pongo et le Jocko." To this title the following note is appended:–

"Orang-outang nom de cet animal aux Indes orientales: Pongo nom de cet animal à Lowando Province de Congo.

"Jocko, Enjocko, nom de cet animal à Congo que nous avons adopté. *En* est l'article que nous avons retranché."

[20] Thus it was that Andrew Battell's "Engeco" became metamorphosed into "Jocko," and, in the latter shape, was spread all over the world, in consequence of the extensive popularity of Buffon's works. The Abbé Prevost and Buffon between them however, did a good deal more disfigurement to Battell's sober account than "cutting off an article." Thus Battell's statement that the Pongos "cannot speake, and have no understanding more than a beast," is rendered by Buffon "qu'il ne peut parler *quoiqu'il ait plus d'entendement que les autres animaux*;" and again, Purchas' affirmation, "He told me in conference with him, that one of these Pongos tooke a negro boy of his which lived a moneth with them," stands in the French version, "un pongo lui enleva un petit negre qui passa un *an* entier dans la société de ces animaux."

After quoting the account of the great Pongo, Buffon justly remarks, that all the "Jockos" and "Orangs" hitherto brought to Europe were young; and he suggests that, in their adult condition, they might be as big as the Pongo or "great Orang;" so that, provisionally, he regarded the Jockos, Orangs, and Pongos as all of one species. And perhaps this was as much as the state of knowledge at the time warranted. But how it came about that Buffon failed to perceive the similarity of Smith's "Mandrill" to his own "Jocko," and confounded the former with so [21] totally different a creature as the blue-faced Baboon, is not so easily intelligible.

Twenty years later Buffon changed his opinion,[8] and expressed his belief that the Orangs constituted a genus with two species,–a large one, the Pongo of Battell, and a small one, the Jocko: that the small one (Jocko) is the East Indian Orang; and that the young animals from Africa, observed by himself and Tulpius, are simply young Pongos.

In the meanwhile, the Dutch naturalist, Vosmaer, gave, in 1778, a very good account and figure of a young Orang, brought alive to Holland, and his countryman, the famous anatomist, Peter Camper, published (1779) an essay on the Orang-Utan of similar value to that of Tyson on the Chimpanzee. He dissected several females and a male, all of which, from the state of their skeleton and their dentition, he justly supposes to have been young. However, judging by the analogy of man, he concludes that they could not have exceeded four feet in height in the adult condition. Furthermore, he is very clear as to the specific distinctness of the true East Indian Orang.

"The Orang," says he, "differs not only from the Pigmy of Tyson and from the Orang of Tulpius by its peculiar colour and its long toes, but also by its whole external form. Its arms, its [22] hands, and its feet are longer, while the thumbs, on the contrary, are much shorter; and the great toes much smaller in proportion."[9] And again, "The true Orang, that is to say, that of Asia, that of Borneo, is consequently not the Pithecus, or tail-less Ape, which the Greeks, and especially Galen, have described. It is neither the Pongo nor the Jocko, nor the Orang of Tulpius, nor the Pigmy of Tyson,–*it is an animal of a peculiar species,* as I shall prove in the clearest manner by the organs of voice and the skeleton in the following chapters" (*l. c.* p. 64).

A few years later, M. Radermacher, who held a high office in the Government of the Dutch dominions in India, and was an active member of the Batavian Society of Arts and Sciences, published, in the second part of the Transactions of that Society,[10] a Description of the Island of Borneo, which was written between the years 1779 and 1781, and, among much other interesting matter, contains some notes upon the Orang. The small sort of Orang-Utan, viz. that of Vosmaer and of Edwards, he says, is found only in Borneo, and chiefly about Banjermassing, Mampauwa, and Landak. Of these he had seen some fifty during his residence in the Indies; but none exceeded 2-1/2 feet in length. The larger sort, [23] often regarded as a chimæra, continues Radermacher, would perhaps long have remained so, had it not been for the exertions of the Resident at Rembang, M. Palm, who, on returning from Landak towards Pontiana, shot one, and forwarded it to Batavia in spirit, for transmission to Europe.

Palm's letter describing the capture runs thus:–"Herewith I send your Excellency, contrary to all expectation (since long ago I offered more than a hundred ducats to the natives for an Orang-Utan of four or five feet high) an Orang which I heard of this morning about eight o'clock. For a long time we did our best to take the frightful beast alive in the dense forest about half way to Landak. We forgot even to eat, so anxious were we not to let him escape; but it was necessary to take care that he did not revenge himself, as he kept continually breaking off heavy pieces of wood and green branches, and dashing them at us. This game lasted till four o'clock in the afternoon, when we determined to shoot him; in which I succeeded very well, and indeed better than I ever shot from a boat before; for the bullet went just into the side of his chest, so that he was not much damaged. We got him into the prow still living, and bound him fast, and next morning he died of his wounds. All Pontiana came on board to see him when we arrived." Palm gives his height from the head to the heel as 49 inches.

[24] A very intelligent German officer, Baron Von Wurmb, who at this time held a post in the Dutch East India service, and was Secretary of the Batavian Society, studied this animal, and his careful

description of it, entitled "Beschrijving van der Groote Borneosche Orang-outang of de Oost-Indische Pongo," is contained in the same volume of the Batavian Society's Transactions. After Von Wurmb had drawn up his description he states, in a letter dated Batavia, Feb. 18,1781,[11] that the specimen was sent to Europe in brandy to be placed in the collection of the Prince of Orange; "unfortunately," he continues, "we hear that the ship has been wrecked." Von Wurmb died in the course of the year 1781, the letter in which this passage occurs being the last he wrote: but in his posthumous papers, published in the fourth part of the Transactions of the Batavian Society, there is a brief description, with measurements, of a female Pongo four feet high.

Did either of these original specimens, on which Von Wurmb's descriptions are based, ever reach Europe? It is commonly supposed that they did; but I doubt the fact. For, appended to the memoir "De l'Ourang-outang," in the collected edition of Camper's works, tome i., pp. 64-66, is a note by Camper himself, [25] referring to Von Wurmb's papers, and continuing thus:–"Heretofore, this kind of ape had never been known in Europe. Radermacher has had the kindness to send me the skull of one of these animals, which measured fifty-three inches, or four feet five inches, in height. I have sent some sketches of it to M. Soemmering at Mayence, which are better calculated, however, to give an idea of the form than of the real size of the parts."

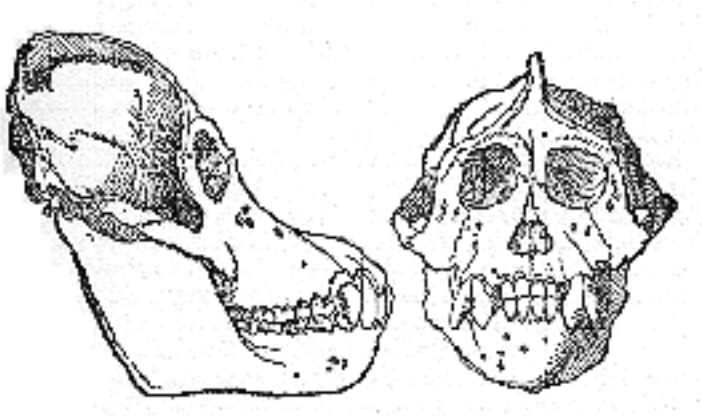

Fig. 7.–The Pongo Skull, sent by Radermacher to Camper, after Camper's original sketches, as reproduced by Lucæ.

These sketches have been reproduced by Fischer and by Lucæ, and bear date 1783, Soemmering having received them in 1784. Had either of Von Wurmb's specimens reached [26] Holland, they would hardly have been unknown at this time to Camper, who, however, goes on to say–"It appears that since this, some more of these monsters have been captured, for an entire skeleton, very badly set up, which had been sent to the Museum of the Prince of Orange, and which I saw only on the 27th of June, 1784, was more than four feet high. I examined this skeleton again on the 19th December, 1785, after it had been excellently put to rights by the ingenious Onymus."

It appears evident, then, that this skeleton, which is doubtless that which has always gone by the name of Wurmb's Pongo, is not that of the animal described by him, though unquestionably similar in all essential points.

Camper proceeds to note some of the most important features of this skeleton; promises to describe it in detail by-and-bye; and is evidently in doubt as to the relation of this great "Pongo" to his "petit Orang."

The promised further investigations were never carried out; and so it happened that the Pongo of Von Wurmb took its place by the side of the Chimpanzee, Gibbon, and Orang as a fourth and colossal species of man-like Ape. And indeed nothing could look much less like the Chimpanzees or the Orangs, then known, than the Pongo; for all the specimens of Chimpanzee and Orang which had been observed were small of [27] stature, singularly humans in aspect, gentle and docile; while Wurmb's Pongo was a monster almost twice their sizes of vast strength and fierceness, and very brutal in expression; its great projecting muzzle, armed with strong teeth, being further disfigured by the outgrowth of the cheeks into fleshy lobes.

Eventually, in accordance with the usual marauding habits of the Revolutionary armies, the "Pongo" skeleton was carried away from Holland into France, and notices of it, expressly intended to demonstrate its entire distinctness from the Orang and its affinity with the baboons, were given, in 1798, by Geoffroy St. Hilaire and Cuvier.

Even in Cuvier's "Tableau Elémentaire," and in the first edition of his great work, the "Regne Animal," the "Pongo" is classed as a species of Baboon. However, so early as 1818, it appears that Cuvier saw reason to alter this opinion, and to adopt the view suggested several years before by Blumenbach,[12] and after him by Tilesius, that the Bornean Pongo is simply an adult Orang. In 1824, Rudolphi demonstrated, by the condition of the dentition, more fully and completely than had been done by his predecessors, that the Orangs described up to that time were all young animals, and that the skull and teeth of the adult [28] would probably be such as those seen in the Pongo of Wurmb. In the second edition of the "Regne Animal" (1829), Cuvier infers, from the "proportions of all the parts" and "the arrangements of the foramina and sutures of the head," that the Pongo is the adult of the Orang-Utan, "at least of a very closely allied species," and this conclusion was eventually placed beyond all doubt by Professor Owen's Memoir published in the "Zoological Transactions" for 1835, and by Temminck in his "Monographies de Mammalogie." Temminck's memoir is remarkable for the completeness of the evidence which it affords as to the modification which the form of the Orang undergoes according to age and sex. Tiedemann first published an account of the brain of the young Orang, while Sandifort, Müller and Schlegel, described the muscles and the viscera of the adult, and gave the earliest detailed and trustworthy history of the habits of the great Indian Ape in a state of nature; and as important additions have been made by later observers, we are at this moment better acquainted with the adult of the Orang-Utan, than with that of any of the other greater man-like Apes.

It is certainly the Pongo of Wurmb;[13] and it is as certainly not the Pongo of Battell, seeing that [29] the Orang-Utan is entirely confined to the great Asiatic islands of Borneo and Sumatra.

And while the progress of discovery thus cleared up the history of the Orang, it also became established that the only other man-like Apes in the eastern world were the various species of Gibbon–Apes of

smaller stature, and therefore attracting less attention than the Orangs, though they are spread over a much wider range of country, and are hence more accessible to observation.

Although the geographical area inhabited by the "Pongo" and "Engeco" of Battell is so much nearer to Europe than that in which the Orang and Gibbon are found, our acquaintance with the African Apes has been of slower growth; indeed, it is only within the last few years that the truthful story of the old English adventurer has been rendered fully intelligible. It was not until 1835 that the skeleton of the adult Chimpanzee became known, by the publication of Professor Owen's above-mentioned very excellent memoir "On the Osteology of the Chimpanzee and Orang," in the Zoological Transactions–a memoir which, by the accuracy of its descriptions, the carefulness of its comparisons, and the excellence of its figures, made an epoch in the history of our knowledge of the bony framework, not only of the Chimpanzee, but of all the anthropoid Apes.

By the investigations herein detailed, it became [30] evident that the old Chimpanzee acquired a size and aspect as different from those of the young known to Tyson, to Buffon, and to Traill, as those of the old Orang from the young Orang; and the subsequent very important researches of Messrs. Savage and Wyman, the American missionary and anatomist, have not only confirmed this conclusion, but have added many new details.[14]

One of the most interesting among the many valuable discoveries made by Dr. Thomas Savage is the fact, that the natives in the Gaboon country at the present day, apply to the Chimpanzee a name–"Enché-eko"–which is obviously identical with the "Engeko" of Battell; a discovery which has been confirmed by all later inquirers. Battell's "lesser monster" being thus proved to be a veritable existence, of course a strong presumption arose that his "greater monster," the "Pongo," would sooner or later be discovered. And, indeed, a modern traveller, Bowdich, had, in 1819, found strong evidence, among the natives, of the existence of a second great Ape, called the "Ingena," "five feet high, and four across the shoulders," the builder of a rude house, on the outside of which it slept.

[31] In 1847, Dr. Savage had the good fortune to make another and most important addition to our knowledge of the man-like Apes; for, being unexpectedly detained at the Gaboon river, he saw in the house of the Rev. Mr. Wilson, a missionary resident there, "a skull represented by the natives to be a monkey-like animal, remarkable for its size, ferocity, and habits." From the contour of the skull, and the information derived from several intelligent natives, "I was induced," says Dr. Savage (using the term Orang in its old general sense) "to believe that it belonged to a new species of Orang. I expressed this opinion to Mr. Wilson, with a desire for further investigation; and, if possible, to decide the point by the inspection of a specimen alive or dead." The result of the combined exertions of Messrs. Savage and Wilson was not only the obtaining of a very full account of the habits of this new creature, but a still more important service to science, the enabling the excellent American anatomist already mentioned, Professor Wyman, to describe, from ample materials, the distinctive osteological characters of the new form. This animal was called by the natives of the Gaboon "Engé-ena," a name obviously identical with the "Ingena" of Bowdich; and Dr. Savage arrived at the conviction that this last discovered of all the great Apes was the long-sought "Pongo" of Battell.

The justice of this conclusion, indeed, is beyond [32] doubt–for not only does the "Engé-ena" agree with Battell's "greater monster" in its hollow eyes, its great stature, and its dun or iron-grey colour, but the only other man-like Ape which inhabits these latitudes–the Chimpanzee–is at once identified, by its smaller size, as the "lesser monster," and is excluded from any possibility of being the "Pongo," by the fact that it is black and not dun, to say nothing of the important circumstance already mentioned that it still retains the name of "Engeko," or "Enché-eko," by which Battell knew it.

In seeking for a specific name for the "Engé-ena," however, Dr. Savage wisely avoided the much misused "Pongo"; but finding in the ancient Periplus of Hanno the word "Gorilla" applied to certain hairy savage people, discovered by the Carthaginian voyager in an island on the African coast, he attached the specific name "*Gorilla*" to his new ape, whence arises its present well-known appellation. But Dr. Savage, more cautious than some of his successors, by no means identifies his ape with Hanno's "wild men." He merely says that the latter were "probably one of the species of the Orang;" and I quite agree with M. Brulle, that there is no grounds for identifying the modern "Gorilla" with that of the Carthaginian admiral.

Since the memoir of Savage and Wyman was published, the skeleton of the Gorilla has been [33] investigated by Professor Owen and by the late Professor Duvernoy, of the Jardin des Plantes, the latter having further supplied a valuable account of the muscular system and of many of the other soft parts; while African missionaries and travellers have confirmed and expanded the account originally given of the habits of this great man-like Ape, which has had the singular fortune of being the first to be made known to the general world and the last to be scientifically investigated.

Two centuries and a half have passed away since Battell told his stories about the "greater" and the "lesser monsters" to Purchas, and it has taken nearly that time to arrive at the clear result that there are four distinct kinds of Anthropoids–in Eastern Asia, the Gibbons and the Orangs; in Western Africa, the Chimpanzees and the Gorilla.

The man-like Apes, the history of the discovery of which has just been detailed, have certain characters of structure and of distribution in common. Thus they all have the same number of teeth as man–possessing four incisors, two canines, four false molars, and six true molars in each jaw, or 32 teeth in all, in the adult condition; while the milk dentition consists of 20 teeth–or four incisors, two canines, and four molars in each jaw. They are what are called catarrhine Apes–that is, their [34] nostrils have a narrow partition and look downwards; and, furthermore, their arms are always longer than their legs, the difference being sometimes greater and sometimes less; so that if the four were arranged in the order of the length of their arms in proportion to that of their legs, we should have this series–Orang (1-4/9–1), Gibbon (1-1/4–1), Gorilla (1-1/5–1), Chimpanzee (1-1/16–1). In all, the fore limbs are terminated by hands, provided with longer or shorter thumbs; while the great toe of the foot, always smaller than in Man, is far more movable than in him and can be opposed, like a thumb, to the rest of the foot. None of these apes have tails, and none of them possess the cheek-pouches common among monkeys. Finally, they are all inhabitants of the old world.

The Gibbons are the smallest, slenderest, and longest-limbed of the man-like apes: their arms are longer in proportion to their bodies than those of any of the other man-like Apes, so that they can touch the ground when erect; their hands are longer than their feet, and they are the only Anthropoids which possess callosities like the lower monkeys. They are variously coloured. The Orangs have arms which reach to the ankles in the erect position of the animal; their thumbs and great toes are very short, and their feet are longer than their hands. They are covered with reddish brown hair, and the sides of the face, in [35] adult males, are commonly produced into two crescentic, flexible excrescences, like fatty tumours. The Chimpanzees have arms which reach below the knees; they have large thumbs and great toes; their hands are longer than their feet; and their hair is black, while the skin of the face is pale. The Gorilla, lastly, has arms which reach to the middle of the leg, large thumbs and great toes, feet longer than the hands, a black face, and dark-grey or dun hair.

For the purpose which I have at present in view, it is unnecessary that I should enter into any further minutiæ respecting the distinctive characters of the genera and species into which these man-like Apes are divided by naturalists. Suffice it to say, that the Orangs and the Gibbons constitute the distinct genera, *Simia* and *Hylobates;* while the Chimpanzees and Gorillas are by some regarded simply as distinct species of one genus, *Troglodytes;* by others as distinct genera–*Troglodytes* being reserved for the Chimpanzees, and *Gorilla* for the Engé-ena or Pongo.

Sound knowledge respecting the habits and mode of life of the man-like Apes has been even more difficult of attainment than correct information regarding their structure.

Once in a generation, a Wallace may be found physically, mentally, and morally qualified to wander unscathed through the tropical wilds of [36] America and of Asia; to form magnificent collections as he wanders; and withal to think out sagaciously the conclusions suggested by his collections: but, to the ordinary explorer or collector, the dense forests of equatorial Asia and Africa, which constitute the favourite habitation of the Orang, the Chimpanzee, and the Gorilla, present difficulties of no ordinary magnitude; and the man who risks his life by even a short visit to the malarious shores of those regions may well be excused if he shrinks from facing the dangers of the interior; if he contents himself with stimulating the industry of the better seasoned natives, and collecting and collating the more or less mythical reports and traditions with which they are too ready to supply him.

In such a manner most of the earlier accounts of the habits of the man-like Apes originated; and even now a good deal of what passes current must be admitted to have no very safe foundation. The best information we possess is that, based almost wholly on direct European testimony, respecting the Gibbons; the next best evidence relates to the Orangs; while our knowledge of the habits of the Chimpanzee and the Gorilla stands much in need of support and enlargement by additional testimony from instructed European eye-witnesses.

It will therefore be convenient in endeavouring to form a notion of what we are justified in [37] believing about these animals, to commence with the best known man-like Apes, the Gibbons and Orangs; and to make use of the perfectly trustworthy information respecting them as a sort of criterion of

the probable truth or falsehood of assertions respecting the others.

Of the Gibbons, half a dozen species are found scattered over the Asiatic islands, Java, Sumatra, Borneo, and through Malacca, Siam, Arracan, and an uncertain extent of Hindostan, on the main land of Asia. The largest attain a few inches above three feet in height, from the crown to the heel, so that they are shorter than the other man-like Apes; while the slenderness of their bodies renders their mass far smaller in proportion even to this diminished height.

Dr. Salomon Müller, an accomplished Dutch naturalist, who lived for many years in the Eastern Archipelago, and to the results of whose personal experience I shall frequently have occasion to refer, states that the Gibbons are true mountaineers, loving the slopes and edges of the hills, though they rarely ascend beyond the limit of the fig-trees. All day long they haunt the tops of the tall trees; and though, towards evening, they descend in small troops to the open ground, no sooner do they spy a man than they dart up the hill-sides, and disappear in the darker valleys.

All observers testify to the prodigious volume of

[38]

Fig. 8.–A Gibbon (*H. Pileatus*), after Wolf.

[39] voice possessed by these animals. According to the writer whom I have just cited, in one of them, the Siamang, "the voice is grave and penetrating, resembling the sounds goek, goek, goek, goek, goek ha ha ha ha haaaaa, and may easily be heard at a distance of half a league." While the cry is being uttered,

the great membranous bag under the throat which communicates with the organ of voice, the so-called "laryngeal sac," becomes greatly distended, diminishing again when the creature relapses into silence.

M. Duvaucel, likewise, affirms that the cry of the Siamang may be heard for miles–making the woods ring again. So Mr. Martin[15] describes the cry of the agile Gibbon as "overpowering and deafening" in a room, and "from its strength, well calculated for resounding through the vast forests." Mr. Waterhouse, an accomplished musician as well as zoologist, says, "The Gibbon's voice is certainly much more powerful than that of any singer I ever heard." And yet it is to be recollected that this animal is not half the height of, and far less bulky in proportion than, a man.

There is good testimony that various species of Gibbon readily take to the erect posture. Mr. George Bennett,[16] a very excellent observer, in describing the habits of a male *Hylobates syndactylus* which remained for some time in his possession, [40] says: "He invariably walks in the erect posture when on a level surface; and then the arms either hang down, enabling him to assist himself with his knuckles; or what is more usual, he keeps his arms uplifted in nearly an erect position, with the hands pendent ready to seize a rope, and climb up on the approach of danger or on the obtrusion of strangers. He walks rather quick in the erect posture, but with a waddling gait, and is soon run down if, whilst pursued, he has no opportunity of escaping by climbing . . . . When he walks in the erect posture he turns the leg and foot outwards, which occasions him to have a waddling gait and to seem bow-legged."

Dr. Burrough states of another Gibbon, the Horlack or Hooluk:

"They walk erect; and when placed on the floor, or in an open field, balance themselves very prettily, by raising their hands over their head and slightly bending the arm at the wrist and elbow, and then run tolerably fast, rocking from side to side; and, if urged to greater speed, they let fall their hands to the ground, and assist themselves forward, rather jumping than running, still keeping the body, however, nearly erect."

Somewhat different evidence, however, is given by Dr. Winslow Lewis:[17]

"Their only manner of walking was on their posterior or inferior extremities, the others being raised upwards to preserve their equilibrium, as [41] rope-dancers are assisted by long poles at fairs. Their progression was not by placing one foot before the other, but by simultaneously using both, as in jumping." Dr. Salomon Müller also states that the Gibbons progress along the ground by short series of tottering jumps, effected only by the hind limbs, the body being held altogether upright.

But Mr. Martin (*l. c.* p. 418), who also speaks from direct observation, says of the Gibbons generally:

"Pre-eminently qualified for arboreal habits, and displaying among the branches amazing activity, the Gibbons are not so awkward or embarrassed on a level surface as might be imagined. They walk erect, with a waddling or unsteady gait, but at a quick pace; the equilibrium of the body requiring to be kept up, either by touching the ground with the knuckles, first on one side then on the other, or by uplifting the arms so as to poise it. As with the Chimpanzee, the whole of the narrow, long sole of the foot is placed upon the ground at once and raised at once,

without any elasticity of step."

After this mass of concurrent and independent testimony, it cannot reasonably be doubted that the Gibbons commonly and habitually assume the erect attitude.

But level ground is not the place where these animals can display their very remarkable and peculiar locomotive powers, and that prodigious activity which almost tempts one to rank them among flying, rather than among ordinary climbing mammals.

[42] Mr. Martin (*l.c.* p. 430) has given so excellent and graphic an account of the movements of a *Hylobates agilis,* living in the Zoological Gardens, in 1840, that I will quote it in full:

"It is almost impossible to convey in words an idea of the quickness and graceful address of her movements: they may indeed be termed aerial, as she seems merely to touch in her progress the branches among which she exhibits her evolutions. In these feats her hands and arms are the sole organs of locomotion; her body hanging as if suspended by a rope, sustained by one hand (the right for example) she launches herself, by an energetic movement, to a distant branch, which she catches with the left hand; but her hold is less than momentary: the impulse for the next launch is acquired: the branch then aimed at is attained by the right hand again and quitted instantaneously, and so on in alternate succession. In this manner spaces of twelve and eighteen feet are cleared, without the slightest appearance of fatigue being manifested; and it is evident that if more space could be allowed, distances very greatly exceeding eighteen feet would be as easily cleared, so that Duvaucel's assertion that he had seen these animals launch themselves from one branch to another, forty feet asunder, startling as it is, may be well credited. Sometimes, on seizing a branch in her progress, she will throw herself, by the power of one arm only, completely round it, making a revolution with such rapidity as almost to deceive the eye, and continue her progress with undiminished velocity. It is singular to observe how suddenly this Gibbon can stop, when the impetus given by the rapidity and distance of her swinging leaps would seem to require a gradual abatement of her movements. In the very midst of her flight a branch is seized, the body raised, and she is seen, as if by magic, quietly seated on it, grasping it with her feet. As suddenly she again throws herself into action.

[43] "The following facts will convey some notion of her dexterity and quickness. A live bird was let loose into in her apartment; she marked its flight, made a long swing to a distant branch, caught the bird with one hand in her passage, and attained the branch with her other hand; her aim, both at the bird and at the branch, being as successful as if one object only had engaged her attention. It may be added that she instantly bit off the head of the bird, picked its feathers, and then threw it down without attempting to eat it.

"On another occasion this animal swung herself from a perch, across a passage at least twelve feet wide, against a window which it was thought would be immediately broken: but not so; to the surprise of all, she caught the narrow framework between the panes with her hand, in an instant attained the proper impetus, and sprang back again to the cage she had left–a feat requiring not only great strength, but the nicest precision."

The Gibbons appear to be naturally very gentle, but there is very good evidence that they will bite severely when irritated–a female *Hylobates agilis*having so severely lacerated one man with her long canines, that he died; while she had injured others so much that, by way of precaution, these formidable teeth had been filed down; but, if threatened, she would still turn on her keeper. The Gibbons eat insects,

but appear generally to avoid animal food. A Siamang, however, was seen by Mr. Bennett to seize and devour greedily a live lizard. They commonly drink by dipping their fingers in the liquid and then licking them. It is asserted that they sleep in a sitting posture.

Duvaucel affirms that he has seen the females carry their young to the waterside and there wash [44] their faces, in spite of resistance and cries. They are gentle and affectionate in captivity–full of tricks and pettishness, like spoiled children, and yet not devoid of a certain conscience, as an anecdote, told by Mr. Bennett (*l. c.* p. 156), will show. It would appear that his Gibbon had a peculiar inclination for disarranging things in the cabin. Among these articles, a piece of soap would especially attract his notice, and for the removal of this he had been once or twice scolded. "One morning," says Mr. Bennett, "I was writing, the ape being present in the cabin, when casting my eyes towards him, I saw the little fellow taking the soap. I watched him without his perceiving that I did so: and he occasionally would cast a furtive glance towards the place where I sat. I pretended to write; he, seeing me busily occupied, took the soap, and moved away with it in his paw. When he had walked half the length of the cabin, I spoke quietly, without frightening him. The instant he found I saw him, he walked back again, and deposited the soap nearly in the same place from whence he had taken it. There was certainly something more than instinct in that action: he evidently betrayed a consciousness of having done wrong both by his first and last actions–and what is reason if that is not an exercise of it?"

The most elaborate account of the natural

[45]

Fig. 9.–An adult male Orang-utan, after Müller and Schlegel.

[46] history of the Orang-utan extant, is that given in the "Verhandelingen over de Natuurlijke

Geschiedenis der Nederlandsche overzeesche Bezittingen (1839-45)," by Dr. Salomon Müller and Dr. Schlegel, and I shall base what I have to say, upon this subject almost entirely on their statements, adding, here and there, particulars of interest from the writings of Brooke, Wallace, and others.

The Orang-Utan would rarely seem to exceed four feet in height, but the body is very bulky, measuring two-thirds of the height in circumference.[18]

The Orang-Utan is found only in Sumatra and Borneo, and is common in neither of these islands–in both of which it occurs always in low, flat plains, never in the mountains. It loves the densest and most sombre of the forests, which [47] extend from the sea-shore inland, and thus is found only in the eastern half of Sumatra, where alone such forests occur, though, occasionally, it strays over to the western side.

On the other hand, it is generally distributed through Borneo, except in the mountains, or where the population is dense. In favourable places, the hunter may, by good fortune, see three or four in a day.

Except in the pairing time, the old males usually live by themselves. The old females, and the immature males, on the other hand, are often met with in twos and threes; and the former occasionally have young with them, though the pregnant females usually separate themselves, and sometimes remain apart after they have given birth to their offspring. The young Orangs seem to remain unusually long under their mother's protection, probably in consequence of their slow growth. While climbing, the mother always carries her young against her bosom, the young holding on by his mother's hair.[19] At what time of life the Orang-Utan becomes capable of propagation, and how long the females go with young, is unknown, but it is probable that they are not adult until they [48] arrive at ten or fifteen years of age. A female which lived for five years at Batavia, had not attained one-third the height of the wild females. It is probable that, after reaching adult years, they go on growing, though slowly, and that they live to forty or fifty years. The Dyaks tell of old Orangs, which have not only lost all their teeth, but which find it so troublesome to climb, that they maintain themselves on windfalls and juicy herbage.

The Orang is sluggish, exhibiting none of that marvellous activity characteristic of the Gibbons. Hunger alone seems to stir him to exertion, and when it is stilled, he relapses into repose. When the animal sits, it curves its back and bows its head, so as to look straight down on the ground; sometimes it holds on with its hands by a higher branch, sometimes lets them hang phlegmatically down by its side–and in these positions the Orang will remain, for hours together, in the same spot, almost without stirring, and only now and then giving utterance to his deep, growling voice. By day, he usually climbs from one tree-top to another, and only at night descends to the ground, and if then threatened with danger, he seeks refuge among the underwood. When not hunted, he remains a long time in the same locality, and sometimes stops for many days on the same tree–a firm place among its branches serving him for a bed. It is rare for the Orang to pass the night in the summit of a large tree, probably because it [49] is too windy and cold there for him; but, as soon as night draws on, he descends from the height and seeks out a fit bed in the lower and darker part, or in the leafy top of a small tree, among which he prefers Nibong Palms, Pandani, or one of those parasitic Orchids which give the primæval forests of Borneo so characteristic and striking an appearance. But wherever he determines to sleep, there he prepares himself

a sort of nest: little boughs and leaves are drawn together round the selected spot, and bent crosswise over one another; while to make the bed soft, great leaves of Ferns, of Orchids, of *Pandanus fascicularis, Nipa fruticans,* &c. are laid over them. Those which Müller saw, many of them being very fresh, were situated at a height of ten to twenty-five feet above the ground, and had a circumference, on the average, of two or three feet. Some were packed many inches thick with *Pandanus* leaves; others were remarkable only for the cracked twigs, which, united in a common centre, formed a regular platform. "The rude hut," says Sir James Brooke, "which they are stated to build in the trees, would be more properly called a seat or nest, for it has no roof or cover of any sort. The facility with which they form this nest is curious, and I had an opportunity of seeing a wounded female weave the branches together and seat herself, within a minute."

According to the Dyaks the Orang rarely leaves [50] his bed before the sun is well above the horizon and has dissipated the mists. He gets up about nine, and goes to bed again about five; but sometimes not till late in the twilight. He lies sometimes on his back; or, by way of change, turns on one side or the other, drawing his limbs up to his body, and resting his head on his hand. When the night is cold, windy, or rainy, he usually covers his body with a heap of *Pandanus, Nipa,* or Fern leaves, like those of which his bed is made, and he is especially careful to wrap up his head in them. It is this habit of covering himself up which has probably led to the fable that the Orang builds huts in the trees.

Although the Orang resides mostly amid the boughs of great trees, during the daytime, he is very rarely seen squatting on a thick branch, as other apes, and particularly the Gibbons, do. The Orang, on the contrary, confines himself to the slender leafy branches, so that he is seen right at the top of the trees, a mode of life which is closely related to the constitution of his hinder limbs, and especially to that of his seat. For this is provided with no callosities, such as are possessed by many of the lower apes, and even by the Gibbons; and those bones of the pelvis, which are termed the ischia, and which form the solid framework of the surface on which the body rests in the sitting posture, are not expanded like those [51] of the apes which possess callosities, but are more like those of man.

An Orang climbs so slowly and cautiously,[20] as, in this act, to resemble a man more than an ape, taking great care of his feet, so that injury of them seems to affect him far more than it does other apes. Unlike the Gibbons, whose forearms do the greater part of the work, as they swing from branch to branch, the Orang never makes even the smallest jump. In climbing, he moves alternately one hand and one foot, or, after having laid fast hold with the hands, he draws up both feet together. In passing from one tree to another, he always seeks out a place where the twigs of both come close together, or interlace. Even when closely pursued, his circumspection is amazing: he shakes the branches to see if they will bear him, and then bending an overhanging bough down by throwing his weight gradually along it, he makes a bridge from the tree he wishes to quit to the next.[21]

On the ground the Orang always goes laboriously and shakily, on all fours. At starting he will run faster than a man, though he may soon be overtaken. The very long arms which, when [52] he runs, are but little bent, raise the body of the Orang remarkably, so that he assumes much the posture of a very old man bent down by age, and making his way along by the help of a stick. In walking, the body is usually

directed straight forward, unlike the other apes, which run more or less obliquely; except the Gibbons, who in these as in so many other respects, depart remarkably from their fellows.

The Orang cannot put its feet flat on the ground, but is supported upon their outer edges, the heel resting more on the ground, while the curved toes partly rest upon the ground by the upper side of their first joint, the two outermost toes of each foot completely resting on this surface. The hands are held in the opposite manner, their inner edges serving as the chief support. The fingers are then bent out in such a manner that their foremost joints, especially those of the two innermost fingers, rest upon the ground by their upper sides, while the point of the free and straight thumb serves as an additional fulcrum.

The Orang never stands on its hind legs, and all the pictures, representing it as so doing, are as false as the assertion that it defends itself with sticks, and the like.

The long arms are of especial use, not only in climbing, but in the gathering of food from boughs to which the animal could not trust his weight. Figs, blossoms, and young leaves of various kinds, [53] constitute the chief nutriment of the Orang; but strips of bamboo two or three feet long were found in the stomach of a male. They are not known to eat living animals.

Although, when taken young, the Orang-Utan soon becomes domesticated, and indeed seems to court human society, it is naturally a very wild and shy animal, though apparently sluggish and melancholy. The Dyaks affirm, that when the old males are wounded with arrows only, they will occasionally leave the trees and rush raging upon their enemies, whose sole safety lies in instant flight, as they are sure to be killed if caught.[22]

[54] But, though possessed of immense strength, it is rare for the Orang to attempt to defend itself; especially when attacked with fire-arms. On such occasions he endeavours to hide himself, or to escape along the topmost branches of the trees, breaking off and throwing down the boughs as he goes. When wounded he betakes himself to the highest attainable point of the tree, and emits a singular cry, consisting at first of high notes, which at length deepen into a low roar, not unlike that of a panther. While giving out the high notes the Orang thrusts out his lips into a funnel shape; but in uttering the low notes he holds his mouth wide open, and at the same time the great throat bag, or laryngeal sac, becomes distended.

According to the Dyaks, the only animal the Orang measures his strength with is the crocodile, who occasionally seizes him on his visits to the water side. But they say that the Orang is more than a match for his enemy, and beats him to death, or rips up his throat by pulling the jaws asunder!

Much of what has been here stated was [55] probably derived by Dr. Müller from the reports of his Dyak hunters; but a large male, four feet high, lived in captivity, under his observation, for a month, and receives a very bad character.

"He was a very wild beast," says Müller, "of prodigious strength, and false and wicked to the last degree.

If any one approached he rose up slowly with a low growl, fixed his eyes in the direction in which he meant to make his attack, slowly passed his hand between the bars of his cage, and then extending his long arm, gave a sudden grip–usually at the face." He never tried to bite (though Orangs will bite one another), his great weapons of offence and defence being his hands.

His intelligence was very great; and Müller remarks that though the faculties of the Orang have been estimated too highly, yet Cuvier, had he seen this specimen, would not have considered its intelligence to be only a little higher than that of the dog.

His hearing was very acute, but the sense of vision seemed to be less perfect. The under lip was the great organ of touch, and played a very important part in drinking, being thrust out like a trough, so as either to catch the falling rain, or to receive the contents of the half cocoa-nut shell full of water with which the Orang was supplied, and which, in drinking, he poured into the trough thus formed.

[56] In Borneo the Orang-Utan of the Malays goes by the name of "*Mias*" among the Dyaks, who distinguish several kinds as *Mias Pappan* or *Zimo, Mias Kassu,* and *Mias Rambi.* Whether these are distinct species, however, or whether they are mere races, and how far any of them are identical with the Sumatran Orang, as Mr. Wallace thinks the Mias Pappan to be, are problems which are at present undecided; and the variability of these great apes is so extensive, that the settlement of the question is a matter of great difficulty. Of the form called "Mias Pappan," Mr. Wallace[23] observes,

"It is known by its large size, and by the lateral expansion of the face into fatty protuberances or ridges, over the temporal muscles, which has been mis-termed callosities, as they are perfectly soft, smooth, and flexible. Five of this form, measured by me, varied only from 4 feet 1 inch to 4 feet 2 inches in height, from the heel to the crown of the head, the girth of the body from 3 feet to 3 feet 7-1/2 inches, and the extent of the out-stretched arms from 7 feet 2 inches to 7 feet 6 inches; the width of the face from 10 to 13-1/2 inches. The colour and length of the hair varied in different individuals, and in different parts of the same individual some possessed a rudimentary nail on the great toe, others none at all; but they otherwise present no external differences on which to establish even varieties of a species.

"Yet, when we examine the crania of these individuals, we find remarkable differences of form, proportion, and dimension, no two being exactly alike. The slope of the profile, and the projection of the muzzle, together with the size of the cranium, [57] offer differences as decided as those existing between the most strongly marked forms of the Caucasian and African crania in the human species. The orbits vary in width and height, the cranial ridge is either single or double, either much or little developed, and the zygomatic aperture varies considerably in size. This variation in the proportions of the crania enables us satisfactorily to explain the marked difference presented by the single-crested and double-crested skulls, which have been thought to prove the existence of two large species of Orang. The external surface of the skull varies considerably in size, as do also the zygomatic aperture and the temporal muscle; but they bear no necessary relation to each other, a small muscle often existing with a large cranial surface, and *vice versa.* Now, those skulls which have the largest and strongest jaws and the widest zygomatic aperture, have the muscles so large that they meet on the crown of the skull, and deposit the bony ridge which supports them, and which is the highest in that which has the smallest cranial surface. In those which combine a large surface with comparatively weak jaws, and small zygomatic aperture, the muscles, on each side, do not extend to the crown, a space of from l to 2 inches remaining between them, and along their

margins small ridges are formed. Intermediate forms are found, in which the ridges meet only in the hinder part of the skull. The form and size of the ridges are therefore independent of age, being sometimes more strongly developed in the less aged animal. Professor Temminck states that the series of skulls in the Leydon Museum shows the same result."

Mr. Wallace observed two male adult Orangs (Mias Kassu of the Dyaks), however, so very different from any of these that he concludes them to be specifically distinct; they were respectively 3 feet 8-1/2 inches and 3 feet 9-1/2 inches high, and possessed no sign of the cheek excrescences, but otherwise resembled the larger kinds. The skull has no crest, but two bony [58] ridges, 1-3/4 inches to 2 inches apart, as in the *Simia morio* of Professor Owen. The teeth, however; are immense, equalling or surpassing those of the other species. The females of both these kinds, according to Mr. Wallace, are devoid of excrescences, and resemble the smaller males, but are shorter by 1-1/2 to 3 inches, and their canine teeth are comparatively small, subtruncated and dilated at the base, as in the so-called *Simia morio,* which is, in all probability, the skull of a female of the same species as the smaller males. Both males and females of this smaller species are distinguishable, according to Mr. Wallace, by the comparatively large size of the middle incisors of the upper jaw.

So far as I am aware, no one has attempted to dispute the accuracy of the statements which I have just quoted regarding the habits of the two Asiatic man-like apes; and if true, they must be admitted as evidence, that such an Ape–

lstly, May readily move along the ground in the erect, or semi-erect, position, and without direct support from its arms.

2ndly, That it may possess an extremely loud voice, so loud as to be readily heard one or two miles.

3rdly, That it may be capable of great viciousness and violence when irritated: and this is especially true of adult males.

[59] 4thly, That it may build a nest to sleep in.

Such being well established facts respecting the Asiatic Anthropoids, analogy alone might justify us in expecting the African species to offer similar peculiarities, separately or combined; or, at any rate, would destroy the force of any attempted *a priori* argument against such direct testimony as might be adduced in favour of their existence. And, if the organization of any of the African Apes could be demonstrated to fit it better than either of its Asiatic allies for the erect position and for efficient attack, there would be still less reason for doubting its occasional adoption of the upright attitude or of aggressive proceedings.

From the time of Tyson and Tulpius downwards, the habits of the young Chimpanzee in a state of captivity have been abundantly reported and commented upon. But trustworthy evidence as to the manners and customs of adult anthropoids of this species, in their native woods, was almost wanting up

to the time of the publication of the paper by Dr. Savage, to which I have already referred; containing notes of the observations which he made, and of the information which he collected from sources which he considered trustworthy, while resident at Cape Palmas, at the north-western limit of the Bight of Benin.

The adult Chimpanzees measured by Dr. Savage, never exceeded, though the males may almost attain, five feet in height.

[60] "When at rest the sitting posture is that generally assumed. They are sometimes seen standing and walking, but when thus detected, they immediately take to all fours, and flee from the presence of the observer. Such is their organisation that they cannot stand erect, but lean forward. Hence they are seen, when standing, with the hands clasped over the occiput, or the lumbar region, which would seem necessary to balance or ease of posture.

"The toes of the adult are strongly flexed and turned inwards, and cannot be perfectly straightened. In the attempt the skin gathers into thick folds on the back, showing that the full expansion of the foot, as is necessary in walking, is unnatural. The natural position is on all fours, the body anteriorly resting upon the knuckles. These are greatly enlarged, with the skin protuberant and thickened like the sole of the foot.

"They are expert climbers, as one would suppose from their organisation. In their gambols they swing from limb to limb to a great distance, and leap with astonishing agility. It is not unusual to see the 'old folks' (in the language of an observer) sitting under a tree regaling themselves with fruit and friendly chat, while their 'children' are leaping around them, and swinging from tree to tree with boisterous merriment.

"As seen here, they cannot be called *gregarious*, seldom more than five, or ten at most, being found together. It has been said, on good authority, that they occasionally assemble in large numbers, in gambols. My informant asserts that he saw once not less than fifty so engaged; hooting, screaming, and drumming with sticks upon old logs, which is done in the latter case with equal facility by the four extremities. They do not appear ever to act on the offensive, and seldom, if ever really, on the defensive. When about to be captured, they resist by throwing their arms about their opponent, and attempting to draw him into contact with their teeth." (Savage, *l.c.* p. 384.)

With respect to this last point Dr. Savage is very explicit in another place:

[61] "*Biting*" is their principal art of defence. I have seen one man who had been thus severely wounded in the feet.

"The strong development of the canine teeth in the adult would seem to indicate a carnivorous propensity; but in no state save that of domestication do they manifest it. The canines are early developed, and evidently designed to act the important part of weapons of defence. When in contact with man almost the first effort of the animal is–to *bite*.

"They avoid the abodes of men, and build their habitations in trees. Their construction is more than of *nests* than *huts*, as they have been erroneously termed by some naturalists. They generally build not far above the ground. Branches or twigs are bent, or partly broken, and crossed, and the whole supported by the body of a limb or a crotch. Sometimes a nest will be found near the *end* of a *strong leafy branch* twenty or thirty feet from the

ground. One I have lately seen that could not be less than forty feet, and more probably it was fifty. But this is an unusual height.

"Their dwelling-place is not permanent, but changes in pursuit of food and solitude, according to the force of circumstances. We more often see them in elevated places; but this arises from the fact that the low grounds, being more favourable for the natives' rice-farms, are the oftener cleared, and hence are almost always wanting in suitable trees for their nests. . . . It is seldom that more than one or two nests are seen upon the same tree, or in the same neighbourhood: five have been found, but it was an unusual circumstance." . . .

"They are very filthy in their habits.... It is a tradition with the natives generally here, that they were once members of their own tribe; that for their depraved habits they were expelled from all human society, and that through an obstinate indulgence of their vile propensities, they have degenerated into the present state and organisation. They are, however, eaten by them, and when cooked with the oil and pulp of the palm-nut considered a highly palatable morsel.

"They exhibit a remarkable degree of intelligence in their habits, and, on the part of the mother, much affection for their [62] young. The second female described was upon a tree when first discovered, with her mate and two young ones (a male and a female). Her first impulse was to descend with great rapidity and make off into the thicket, with her mate and female offspring. The young male remaining behind, she soon returned to the rescue. She ascended and took him in her arms, at which moment she was shot, the ball passing through the fore-arm of the young one, on its way to the head of the mother....

"In a recent case, the mother, when discovered remained upon the tree with her offspring, watching intently the movements of the hunter. As he took aim, she motioned with her hand, precisely in the manner of a human being, to have him desist and go away. When the wound has not proved instantly fatal, they have been known to stop the flow of blood by pressing with the hand upon the part, and when this did not succeed, to apply leaves and grass . . . . When shot, they give a sudden screech, not unlike that of a human being in sudden and acute distress."

The ordinary voice of the Chimpanzee, however, is affirmed to be hoarse, guttural, and not very loud, somewhat like "whoo-whoo." (*l. c.* p. 365.)

The analogy of the Chimpanzee to the Orang, in its nest-building habit and in the mode of forming its nest, is exceedingly interesting; while, on the other hand, the activity of this ape, and its tendency to bite, are particulars in which it rather resembles the Gibbons. In extent of geographical range, again, the Chimpanzees–which are found from Sierra Leone to Congo–remind one of the Gibbons, rather than of either of the other manlike apes; and it seems not unlikely that, as is the case with the Gibbons, there may be several [63] species spread over the geographical area of the genus.

The same excellent observer, from whom I have borrowed the preceding account of the habits of the adult Chimpanzee, published fifteen years ago,[24] an account of the Gorilla, which has, in its most essential points, been confirmed by subsequent observers, and to which so very little has really been added, that in justice to Dr. Savage I give it almost in full.

"It should be borne in mind that my account is based upon the statements of the aborigines of that region (the

Gaboon). In this connection, it may also be proper for me to remark, that having been a missionary resident for several years, studying, from habitual intercourse, the African mind and character, I felt myself prepared to discriminate and decide upon the probability of their statements. Besides, being familiar with the history and habits of its interesting congener (*Trog. niger*, Geoff.), I was able to separate their accounts of the two animals, which, having the same locality and a similarity of habit, are confounded in the minds of the mass, especially as but few–such as traders to the interior and huntsmen–have ever seen the animal in question.

"The tribe from which our knowledge of the animal is derived, and whose territory forms its habitat, is the *Mpongwe,* occupying both banks of the River Gaboon, from its mouth to some fifty or sixty miles upward....

"If the word 'Pongo' be of African origin, it is probably a corruption of the word *Mpongwe,* the name of the tribe on the banks of the Gaboon, and hence applied to the region they inhabit. Their local name for the Chimpanzee is *Enché-eko,* as

[64]

Fig. 10.–The Gorilla, after Wolf.

[65] near as it can be Anglicised, from which the common term 'Jocko' probably comes. The Mpongwe appellation for its new congener is *Engé-ena,* prolonging the sound of the first vowel, and slightly sounding the second.

"The habitat of the *Engé-ena* is the interior of lower Guinea, whilst that of the *Enché-eko* is nearer the sea-board.

"Its height is about five feet; it is disproportionately broad across the shoulders, thickly covered with coarse black hair, which is said to be similar in its arrangement to that of the *Enché-eko;* with age it becomes gray, which fact has given rise to the report that both animals are seen of different colours.

"*Head.*–The prominent features of the head are, the great width and elongation of the face, the depth of the molar

region, the branches of the lower jaw being very deep and extending far backward, and the comparative smallness of the cranial portion; the eyes are very large, and said to be like those of the Enché-eko, a bright hazel; nose broad and flat, slightly elevated towards the root; the muzzle broad, and prominent lips and chin, with scattered gray hairs; the under lip highly mobile, and capable of great elongation when the animal is enraged, then hanging over the chin; skin of the face and ears naked, and of a dark brown, approaching to black.

"The most remarkable feature of the head is a high ridge, or crest of hair, in the course of the sagittal suture, which meets posteriorily with a transverse ridge of the same, but less prominent, running round from the back of one ear to the other. The animal has the power of moving the scalp freely forward and back, and when enraged is said to contract it strongly over the brow, thus bringing down the hairy ridge and pointing the hair forward, so as to present an indescribably ferocious aspect.

"Neck short, thick, and hairy; chest and shoulders very broad, said to be fully double the size of the Enché-ekos; arms very long, reaching some way below the knee–the fore-arm much the shortest; hands very large, the thumbs much larger than the fingers. ...

"The gait is shuffling; the motion of the body, which is never [66] upright as in man, but bent forward, is somewhat rolling, or from side to side. The arms being longer than the Chimpanzee, it does not stoop as much in walking; like that animal, it makes progression by thrusting its arms forward, resting the hands on the ground, and then giving the body a half jumping half swinging motion between them. In this act it is said not to flex the fingers, as does the Chimpanzee, resting on its knuckles, but to extend them, making a fulcrum of the hand. When it assumes the walking posture, to which it is said to be much inclined, it balances its huge body by flexing its arms upward.

Fig. 11–Gorilla walking (after Wolff).

"They live in bands, but are not so numerous as the Chimpanzees; the females generally exceed the other sex in number. My informants all agree in the assertion that but one adult male is seen in a band; that when the young males grow up, a contest takes place for mastery, and the strongest, by killing and driving out the others, establishes himself as the head of the community."

Dr. Savage repudiates the stories about the Gorillas carrying off women and vanquishing elephants and then adds–

[67] "Their dwellings, if they may be so called, are similar to those of the Chimpanzee, consisting simply of a few sticks and leafy branches, supported by the crotches and limbs of trees: they afford no shelter, and are

occupied only at night.

"They are exceedingly ferocious, and always offensive in their habits, never running from man, as does the Chimpanzee. They are objects of terror to the natives, and are never encountered by them except on the defensive. The few that have been captured were killed by elephant hunters and native traders, as they came suddenly upon them while passing through the forests.

"It is said that when the male is first seen he gives a terrific yell, that resounds far and wide through the forest, something like kh–ah! kh–ah! prolonged and shrill. His enormous jaws are widely opened at each expiration, his under lip hangs over the chin, and the hairy ridge and scalp are contracted upon the brow, presenting an aspect of indescribable ferocity.

"The females and young, at the first cry, quickly disappear. He then approaches the enemy in great fury, pouring out his horrid cries in quick succession. The hunter awaits his approach with his gun extended; if his aim is not sure, he permits the animal to grasp the barrel, and as he carries it to his mouth (which is his habit) he fires. Should the gun fail to go off, the barrel (that of the ordinary musket, which is thin) is crushed between his teeth, and the encounter soon proves fatal to the hunter.

"In the wild state, their habits are in general like those of the *Troglodytes niger*, building their nests loosely in trees, living on similar fruits, and changing their place of resort from force of circumstances."

Dr. Savage's observations were confirmed and supplemented by those of Mr. Ford, who communicated an interesting paper on the Gorilla to the Philadelphian Academy of Sciences, in 1852. With respect to the geographical distribution of [68] this greatest of all the man-like Apes, Mr. Ford remarks:

"This animal inhabits the range of mountains that traverse the interior of Guinea, from the Cameroon in the north, to Angola in the south, and about 100 miles inland, and called by the geographers Crystal Mountains. The limit to which this animal extends, either north or south, I am unable to define. But that limit is doubtless some distance north of this river [Gaboon]. I was able to certify myself of this fact in a late excursion to the head-waters of the Mooney (Danger) River, which comes into the sea some sixty miles from this place. I was informed (credibly, I think) that they were numerous among the mountains in which that river rises, and far north of that.

"In the south, this species extends to the Congo River, as I am told by native traders who have visited the coast between the Gaboon and that river. Beyond that, I am not informed. This animal is only found at a distance from the coast in most cases, and, according to my best information, approaches it nowhere so nearly as on the south side of this river, where they have been found within ten miles of the sea. This, however, is only of late occurrence. I am informed by some of the oldest Mpongwe men that formerly he was only found on the sources of the river; but that at present he may be found within half-a-day's walk of its mouth. Formerly he inhabited the mountainous ridge where Bushmen alone inhabited, but now he boldly approaches the Mpongwe plantations. This is doubtless the reason of the scarcity of information in years past, as the opportunities for receiving a knowledge of the animal have not been wanting; traders having for one hundred years frequented this river, and specimens, such as have been brought here within a year, could not have been exhibited without having attracted the attention of the most stupid."

One specimen Mr. Ford examined weighed 170 1bs., without the thoracic, or pelvic, viscera, [69] and

measured four feet four inches round the chest. This writer describes so minutely and graphically the onslaught of the Gorilla–though he does not for a moment pretend to have witnessed the scene–that I am tempted to give this part of his paper in full, for comparison with other narratives:

"He always rises to his feet when making an attack, though he approaches his antagonist in a stooping posture.

"Though he never lies in wait, yet, when he hears, sees, or scents a man, he immediately utters his characteristic cry, prepares for an attack, and always acts on the offensive. The cry he utters resembles a grunt more than a growl, and is similar to the cry of the Chimpanzee, when irritated, but vastly louder. It is said to be audible at a great distance. His preparation consists in attending the females and young ones, by whom he is usually accompanied, to a little distance. He, however, soon returns, with his crest erect and projecting forward, his nostrils dilated, and his under-lip thrown down at the same time uttering his characteristic yell, designed it would seem, to terrify his antagonist. Instantly, unless he is disabled by a well directed shot, he makes an onset, and, striking his antagonist with the palm of his hands, or seizing him with a grasp from which there is no escape, he dashes him upon the ground, and lacerates him with his tusks.

"He is said to seize a musket, and instantly crush the barrel between his teeth. . . . This animal's savage nature is very well shown by the implacable desperation of a young one that was brought here. It was taken very young, and kept four months, and many means were used to tame it; but it was incorrigible, so that it bit me an hour before it died."

Mr. Ford discredits the house-building and elephant-driving stories, and says that no well-[70]informed natives believe them. They are tales told to children.

I might quote other testimony to a similar effect, but, as it appears to me, less carefully weighed and sifted, from the letters of MM. Franquet and Gautier Laboullay, appended to the memoir of M. I. G. St. Hilaire, which I have already cited.

Bearing in mind what is known regarding the Orang and the Gibbon, the statements of Dr. Savage and Mr. Ford do not appear to me to be justly open to criticism on *a priori* grounds. The Gibbons, as we have seen, readily assume the erect posture, but the Gorilla is far better fitted by its organization for that attitude than are the Gibbons: if the laryngeal pouches of the Gibbons, as is very likely, are important in giving volume to a voice which can be heard for half a league, the Gorilla, which has similar sacs, more largely developed, and whose bulk is fivefold that of a Gibbon, may well be audible for twice that distance. If the Orang fights with its hands, the Gibbons and Chimpanzees with their teeth, the Gorilla may, probably enough, do either or both; nor is there anything to be said against either Chimpanzee or Gorilla building a nest, when it is proved that the Orang-Utan habitually performs that feat.

With all this evidence, now ten to fifteen years old, before the world it is not a little surprising [71] that the assertions of a recent traveller, who, so far as the Gorilla is concerned, really does very little more than repeat, on his own authority, the statements of Savage and of Ford, should have met with so much and such bitter opposition. If subtraction be made of what was known before, the sum and substance of what M. Du Chaillu has affirmed as a matter of his own observation respecting the Gorilla, is, that, in

advancing to the attack, the great brute beats his chest with his fists. I confess I see nothing very improbable, or very much worth disputing about, in this statement.

With respect to the other man-like Apes of Africa, M. Du Chaillu tells us absolutely nothing, of his own knowledge, regarding the common Chimpanzee; but he informs us of a bald-headed species or variety, the *nschiego mbouve*, which builds itself a shelter, and of another rare kind with a comparatively small face, large facial angle, and peculiar note, resembling "Kooloo."

As the Orang shelters itself with a rough coverlet of leaves, and the common Chimpanzee, according to that eminently trustworthy observer Dr. Savage, makes a sound like "Whoo-whoo,"–the grounds of the summary repudiation with which M. Du Chaillu's statements on these matters have been met are not obvious.

If I have abstained from quoting M. Du Chaillu's work, then, it is not because I discern any in[72]herent improbability in his assertions respecting the man-like Apes; nor from any wish to throw suspicion on his veracity; but because, in my opinion, so long as his narrative remains in its present state of unexplained and apparently inexplicable confusion, it has no claim to original authority respecting any subject whatsoever. It may be truth, but it is not evidence.

[73]

African Cannibalism in the Sixteenth Century.

In turning over Pigafetta's version of the narrative of Lopez, which I have quoted above, I came upon so curious and unexpected an anticipation, by some two centuries and a half, of one of the most startling parts of M. Du Chaillu's narrative, that I cannot refrain from drawing attention to it in a note, although I must confess that the subject is not strictly relevant to the matter in hand.

In the fifth chapter of the first book of the "Descriptio," "Concerning the northern part of the kingdom of Congo and its boundaries," is mentioned a people whose king is called "Maniloango," and who live under the equator, and as far westward as Cape Lopez. This appears to be the country now inhabited by the Ogobai and Bakalai according to M. Du Chaillu.–"Beyond these dwell another people called 'Anziques,' of incredible ferocity, for they eat one another, sparing neither friends nor relations."

These people are armed with small bows bound tightly round with snake skins, and strung with a reed or rush. Their arrows, short and slender, but made of hard wood, are shot with great rapidity. They have iron axes, the handles of which are bound round with snake skins, and swords with scabbards of the same material; for defensive armour they employ elephant hides. They cut their skins when young, so as to produce scars. "Their butchers' shops are filled with human flesh instead of that of oxen or sheep. For they eat the enemies whom they take in battle. They fatten, slay and devour their slaves also, unless [74] they think they shall get a good price for them; and, moreover, sometimes for weariness of life or desire of glory (for

Fig. 12.–Butcher's Shop of the Anziques Anno 1598.

they think [75] it a great thing and the sign of a generous soul to despise life), or for love of their rulers, offer themselves up for food."

"There are indeed many cannibals, as in the Eastern Indies and in Brazil and elsewhere, but none such as these, since the others only eat their enemies, but these their own blood relations."

The careful illustrators of Pigafetta have done their best to enable the reader to realize this account of the "Anziques," and the unexampled butcher's shop represented in Fig. 12, is a facsimile of part of their Plate XII.

M. Du Chaillu's account of the Fans accords most singularly with what Lopez here narrates of the Anziques. He speaks of their small crossbows and little arrows, of their axes and knives "ingeniously sheathed in snake skins." "They tattoo themselves more than any other tribes I have met north of the equator." And all the world knows what M. Du Chaillu says of their cannibalism–"Presently we passed a woman who solved all doubt. She bore with her a piece of the thigh of a human body, just as we should go to market and carry thence a roast or steak." M. Du Chaillu's artist cannot generally be accused of any want of courage in embodying the statements of his author, and it is to be regretted that, with so good an excuse, he has not furnished us with a fitting companion to the sketch of the brothers De Bry.

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[1] Regnum Congo: hoc est Vera Descriptio Regni Africani quod tam ab incolis quam Lusitanis Congus appellatur, per Philippum Pigafettam olim ex Edoardo Lopez acroamatis lingua Italica excerpta, num Latio sermone donata ab August. Cassiod. Reinio. Iconibus et imaginibus rerum memorabilium quasi vivis, opera et industria Joan. Theodori et Joan. Israelis de Bry, fratrum exornata. Franco-furti, MDXCVIII.

[2] "Except this that their legges had no calves."–[Ed. 1626] And in a marginal note, "These great apes are called Pongo's."

[3] *Purchas' note*.–Cape Negro is in 16 degrees south of the line.

[4] *Purchas' marginal note,* p. 982–" The Pongo a giant ape. He told me in conference with him that one of these Pongoes tooke a negro boy of his which lived a moneth with them. For they hurt not those which they surprise at unawares, except they look on them; which he avoyded. He said their highth was like a man's, but their bignesse twice as great. I saw the negro boy. What the other monster should be he hath forgotten to relate; and these papers came to my mind since his death which, otherwise, in my often conferences, I might have learned. Perhaps he meaneth the Pigmy Pongo killers mentioned."

[5] *Archives du Museum,* Tome X.

[6] I am indebted to Dr. Wright, of Cheltenham, whose paleontological labours are so well known, for bringing this interesting relic to my knowledge. Tyson's granddaughter, it appears, married Dr. Allardyce, a physician of repute in Cheltenham, and brought, as part of her dowry, the skeleton of the "Pygmie." Dr. Allardyce presented it to the Cheltenham Museum, and, through the good offices of my friend Dr. Wright, the authorities of the Museum have permitted me to borrow what is, perhaps, its most remarkable ornament.

[7] "Mandrill" seems to signify a "man-like ape," the word "Drill" or Dril" having been anciently employed in England to denote an Ape or Baboon. Thus in the fifth edition of Blount's "*Glossographia,* or a Dictionary interpreting the hard words of whatsoever language now used in our refined English tongue... very useful for all such as desire to understand what they read," published in 1681, I find, "Dril–a stonecutter's tool wherewith he bores little holes in marble, &c. Also a large overgrown Ape and Baboon, so called." "Drill" is used in the same sense in Charleton's *Onamasticon Zoicon,* 1668. The singular etymology of the word given by Buffon seems hardly a probable one.

[8] *Histoire Naturelle,* Suppl. Tome 7ème, 1789.

[9] Camper, *Œuvres,* i., p. 56.

[10] *Verhandelingen van het Bataviaasch Genootschap.* Tweede Deel. Derde Druk. 1826.

[11] "Briefe des Herrn. v. Wurmb und des H. Baron von Wollzogen. Gotha, 1794."

[12] See Blumenbach *Abbildungen Naturhistorischen Gegenstände,* No. 12, 1810; and Tilesius, *Naturhistorische Früchte der ersten Kaiserlich-Russischen Erdumsegelung,* p. 115, 1813.

[13] Speaking broadly and without prejudice to the question, whether there be more than one species of Orang.

[14] See "Observations on the external characters and habits of the Troglodytes niger, by Thomas N. Savage, M.D., and on its organization, by Jeffries Wyman, M.D.," *Boston Journal of Natural History,* vol. iv. 1843-4; and "External characters, habits, and osteology of Troglodytes Gorilla," by the same authors, ibid. vol. v, 1847.

[15] *Man and Monkies,* p. 423.

[16] *Wanderings in New South Wales,* vol. ii. chap. viii. 1834.

[17] *Boston Journal of Natural History,* vol. i. 1834.

[18] The largest Orang-Utan, cited by Temminck, measured when standing upright, four feet; but he mentions having just received news of the capture of an Orang five feet three inches high. Schlegel and Müller say that their largest old male measured, upright, 1.25 Netherlands "el"; and from the crown to the end of the toes 1.5 el; the circumference of the body being about 1 el. The largest old female was 1.09 el high when standing. The adult skeleton in the College of Surgeons' Museum, if set upright, would stand 3 ft. 6-8 in. from crown to sole. Dr. Humphry gives 3 ft. 8 in. as the mean height of two Orangs. Of seventeen Orangs examined by Mr. Wallace the largest was 4 ft. 2 in. high, from the heel to the crown of the head. Mr. Spencer St. John, however, in his *Life in the Forests of the Far East,* tells us of an Orang of "5 ft. 2 in., measuring fairly from the head to the heel," 15 in. across the face, and 12 in. round the wrist. It does not appear, however, that St. John measured this Orang himself.

[19] See Mr. Wallace's account of an infant "Orang-utan," in the *Annals of Natural History* for 1856. Mr. Wallace provided his interesting charge with an artificial mother of buffalo-skin, but tbe cheat was too successful. The infant's entire experience led it to associate teats with hair, and feeling the latter, it spent its existence in vain endeavours to discover the former.

[20] "They are the slowest and least active of all the monkey tribe, and their motions are surprisingly awkward and uncouth."–Sir James Brooke, in the *Proceedings of the Zoological Society,* 1841.

[21] Mr. Wallace's account of the progression of the Orang almost exactly corresponds with this.

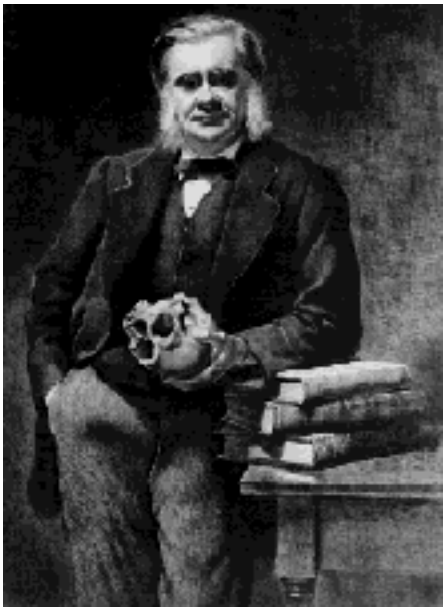
[22] Sir James Brooke, in a letter to Mr. Waterhouse published in the proceedings of the Zoological Society for 1841, says:–"On the habits of the Orangs, as far as I have been able to observe them, I may remark that they are as dull and slothful as can well be conceived, and on no occasion, when pursuing them, did they move so fast as to preclude my keeping pace with them easily through a moderately clear forest, and even when obstructions below (such as wading up to the neck) allowed them to get away some distance, they were sure to stop and allow me to come up. I never observed the slightest attempt at defence, and the wood which sometimes rattled about our ears was broken by their weight, and not thrown, as some persons represent. If pushed to extremity, however, the *Pappan* could not be otherwise than formidable, and one unfortunate man, who, with a party, was trying to catch a large one alive, lost two of his fingers, besides being severely bitten on the face, whilst the animal finally beat off his pursuers and escaped."

Mr. Wallace, on the other hand, affirms that he has several times observed them throwing down branches when pursued. "It is true he does not throw them *at* a person, but casts them down vertically; for it is evident that a bough cannot be thrown to any distance from the top of a lofty tree. In one case a female Mias, on a durian tree, kept up for at least ten minutes a continuous shower of branches and of the heavy, spined fruits, as large as 32-pounders, which most effectually kept us clear of the tree she was on. She could be seen breaking them off and throwing them down with every appearance of rage, uttering at intervals a loud pumping grunt, and evidently meaning mischief."–"On the Habits of the Orang-Utan," *Annals of Natural History,* 1856. This statement, it will be observed, is quite in accordance with that contained in the letter of the Resident Palm quoted above (p. 23).

[23] On the Orang-Utan, or Mias of Borneo, *Annals of Natural History,* 1856.

[24] Notice of the external characters and habits of Troglodytes Gorilla. *Boston Journal of Natural History*, 1847.

THE HUXLEY FILE



Preface and Table of Contents to Volume VII, *Man's Place in Nature*, of Huxley's *Collected Essays*.

Next article: On the Relations of Man to the Lower Animals, pages 77-156.

C. Blinderman & D. Joyce
Clark University

[76]

Skeletons of the

Gibbon. Orang. Chimpanzee. Gorilla. Man.

Photographically reduced from Diagrams of the natural size (except that of the Gibbon, which was twice as large as nature), drawn by Mr. Waterhouse Hawkins from specimens in the Museum of the Royal College of Surgeons.

[77]

II

On the Relations of Man to the Lower Animals< (1861)

Collected Essays VII

Multis videri poterit, majorem esso differentiam Simiæ et Hominis, quam diei et noctis; verum tamen hi, comparatione instituta inter summos Europæ Heroës et Hottentottes ad Caput bonæ spei degentes, difficillime sibi persuadebunt, has eosdem habere natales; vel si virginem nobilem aulicam, maxime comtam et humanissimam, conferre vellent cum homine sylvestri et sibi relicto, vix augurari possent, hunc et illam ejusdem esse speciei.–*Linnæi Amoœnitates Acad. "Anthropomorpha."*

The question of questions for mankind–the problem which underlies all others, and is more deeply interesting than any other–is the ascertainment of the place which Man occupies in nature and of his relations to the universe of things. Whence our race has come; what are the limits of our power over nature, and of nature's power over us; to what goal we are tending; are the problems which present themselves anew and with undiminished interest to [78] every man born into the world. Most of us,

shrinking from the difficulties and dangers which beset the seeker after original answers to these riddles, are contented to ignore them altogether, or to smother the investigating spirit under the feather-bed of respected and respectable tradition. But, in every age, one or two restless spirits, blessed with that constructive genius, which can only build on a secure foundation, or cursed with the spirit of mere scepticism, are unable to follow in the well-worn and comfortable track of their forefathers and contemporaries, and unmindful of thorns and stumbling-blocks, strike out into paths of their own. The sceptics end in the infidelity which asserts the problem to be insoluble, or in the atheism which denies the existence of any orderly progress and governance of things: the men of genius propound solutions which grow into systems of Theology or of Philosophy, or veiled in musical language which suggests more than it asserts, take the shape of the Poetry of an epoch.

Each such answer to the great question, invariably asserted by the followers of its propounder, if not by himself, to be complete and final, remains in high authority and esteem, it may be for one century, or it may be for twenty: but, as invariably, Time proves each reply to have been a mere approximation to the truth–tolerable chiefly on account of the ignorance of those by whom it was accepted, and wholly intolerable [79] when tested by the larger knowledge of their successors.

In a well-worn metaphor, a parallel is drawn between the life of man and the metamorphosis of the caterpillar into the butterfly; but the comparison may be more just as well as more novel, if for its former term we take the mental progress of the race. History shows that the human mind, fed by constant accessions of knowledge, periodically grows too large for its theoretical coverings, and bursts them asunder to appear in new habiliments, as the feeding and growing grub, at intervals, casts its too narrow skin and assumes another, itself but temporary. Truly the imago state of Man seems to be terribly distant, but every moult is a step gained, and of such there have been many.

Since the revival of learning, whereby the Western races of Europe were enabled to enter upon that progress towards true knowledge, which was commenced by the philosophers of Greece, but was almost arrested in subsequent long ages of intellectual stagnation, or, at most, gyration, the human larva has been feeding vigorously, and moulting in proportion. A skin of some dimension was cast in the 16th century, and another towards the end of the 18th, while, within the last fifty years, the extraordinary growth of every department of physical science has spread among us mental food of so nutritious and stimulating a [80] character that a new ecdysis seems imminent. But this is a process not unusually accompanied by many throes and some sickness and debility, or, it may be, by graver disturbances; so that every good citizen must feel bound to facilitate the process, and even if he have nothing but a scalpel to work withal, to ease the cracking integument to the best of his ability.

In this duty lies my excuse for the publication of these essays. For it will be admitted that some knowledge of man's position in the animate world is an indispensable preliminary to the proper understanding of his relations to the universe; and this again resolves itself, in the long run, into an inquiry into the nature and the closeness of the ties which connect him with those singular creatures whose history[1] has been sketched in the preceding pages.

The importance of such an inquiry is indeed intuitively manifest. Brought face to face with these blurred copies of himself, the least thoughtful of men is conscious of a certain shock, due perhaps, not so much to disgust at the aspect of what looks like an insulting caricature, as to the awakening of a sudden and profound mistrust of time-honoured theories and strongly-rooted prejudices regarding his own position in nature, and [81] his relations to the under-world of life; while that which remains a dim suspicion for the unthinking, becomes a vast argument, fraught with the deepest consequences, for all who are acquainted with the recent progress of the anatomical and physiological sciences.

I now propose briefly to unfold that argument, and to set forth, in a form intelligible to those who possess no special acquaintance with anatomical science, the chief facts upon which all conclusions respecting the nature and the extent of the bonds which connect man with the brute world must be based: I shall then indicate the one immediate conclusion which, in my judgment, is justified by those facts, and I shall finally discuss the bearing of that conclusion upon the hypotheses which have been entertained respecting the Origin of Man.

The facts to which I would first direct the reader's attention, though ignored by many of the professed instructors of the public mind, are easy of demonstration and are universally agreed to by men of science; while their significance is so great, that whoso has duly pondered over them will, I think, find little to startle him in the other revelations of Biology. I refer to those facts which have been made known by the study of Development.

It is a truth of very wide, if not of universal, [82] application, that every living creature commences its existence under a form different from, and simpler than, that which it eventually attains.

The oak is a more complex thing than the little rudimentary plant contained in the acorn; the caterpillar is more complex than the egg; the butterfly than the caterpillar; and each of these beings, in passing from its rudimentary to its perfect condition, runs through a series of changes, the sum of which is called its Development. In the higher animals these changes are extremely complicated; but, within the last half century, the labours of such men as Von Baer, Rathke, Reichert, Bischoff, and Remak, have almost completely unravelled them, so that the successive stages of development which are exhibited by a Dog, for example, are now as well known to the embryologist as are the steps of the metamorphosis of the silk-worm moth to the school-boy. It will be useful to consider with attention the nature and the order of the stages of canine development, as an example of the process in the higher animals generally.

The dog, like all animals, save the very lowest (and further inquiries may not improbably remove the apparent exception), commences its existence as an egg: as a body which is, in every sense, as much an egg as that of a hen, but is devoid of that accumulation of nutritive matter which confers upon the bird's egg its exceptional size and [83] domestic utility; and wants the shell, which would not only be useless to an animal incubated within the body of its parent, but would cut it off from access to the source of that nutriment which the young creature requires, but which the minute egg of the mammal does not contain within itself.

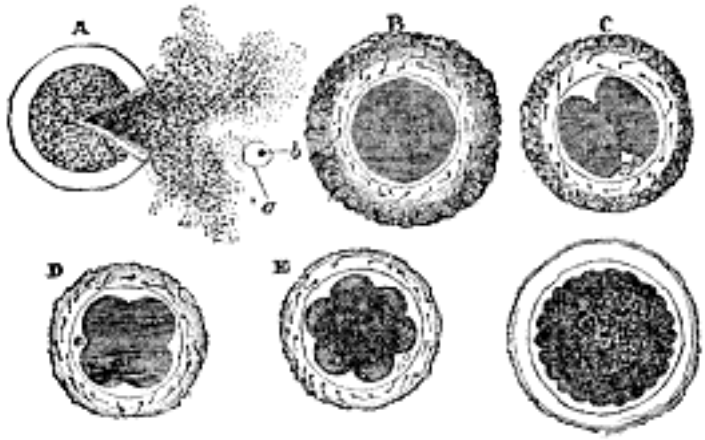


Fig. 13.–A. Egg of the Dog, with the vitelline membrane burst, so as to give exit to the yelk, the germinal vesicle (*a*), and its included spot (*b*). B. C. D. E. F. Successive changes of the yelk indicated in the text. After Bischoff.

The Dog's egg is, in fact, a little spheroidal bag (Fig. 13), formed of a delicate transparent membrane called the *vitelline membrane,* and about 1/130th to 1/120th of an inch in diameter. It contains a [84] mass of viscid nutritive matter–the *yelk*–within which is enclosed a second much more delicate spheroidal bag, called the *germinal vesicle (a).* In this, lastly, lies a more solid rounded body, termed the *germinal spot (b).*

The egg, or Ovum is originally formed within a gland, from which, in due season, it becomes detached, and passes into the living chamber fitted for its protection and maintenance during the protracted process of gestation. Here, when subjected to the required conditions, this minute and apparently insignificant particle of living matter becomes animated by a new and mysterious activity. The germinal vesicle and spot cease to be discernible (their precise fate being one of the yet unsolved problems of embryology), but the yelk becomes circumferentially indented, as if an invisible knife had been drawn round it, and thus appears divided into two hemispheres (Fig. 13, C).

By the repetition of this process in various planes, these hemispheres become subdivided, so that four segments are produced (D); and these, in like manner, divide and subdivide again, until the whole yelk is converted into a mass of granules, each of which consists of a minute spheroid of yelk-substance, inclosing a central particle, the so-called *nucleus* (F). Nature, by this process, has attained much the same result as that which a human artificer arrives at by his [85] operations in a brick-field. She takes the rough plastic material of the yelk and breaks it up into well-shaped tolerably even-sized masses–handy for building up into any part of the living edifice.

Next, the mass of organic bricks, or *cells* as they are technically called, thus formed, acquires an orderly arrangement, becoming converted into a hollow spheroid with double walls. Then, upon one side of this spheroid, appears a thickening, and, by and bye, in the centre of the area of thickening, a straight shallow groove (Fig. 14, A) marks the central line of the edifice which is to be raised, or, in other words, indicates the position of the middle line of the body of the future dog. The substance bounding the groove on each side next rises up into a fold, the rudiment of the side wall of that long cavity, which will eventually lodge the spinal marrow and the brain; and in the floor of this chamber appears a solid

cellular cord, the so-called *notochord.* One end of the enclosed cavity dilates to form the head (Fig. 14, B), the other remains narrow, and eventually becomes the tail; the side walls of the body are fashioned out of the downward continuation of the walls of the groove; and from them, by and bye, grow out little buds which, by degrees, assume the shape of limbs. Watching the fashioning process stage by stage, one is forcibly reminded of the modeller in clay. Every part, every organ, is at first, as it were [86] pinched up rudely, and sketched out in the rough; then shaped more accurately; and only, at last, receives the touches which stamp its final character.

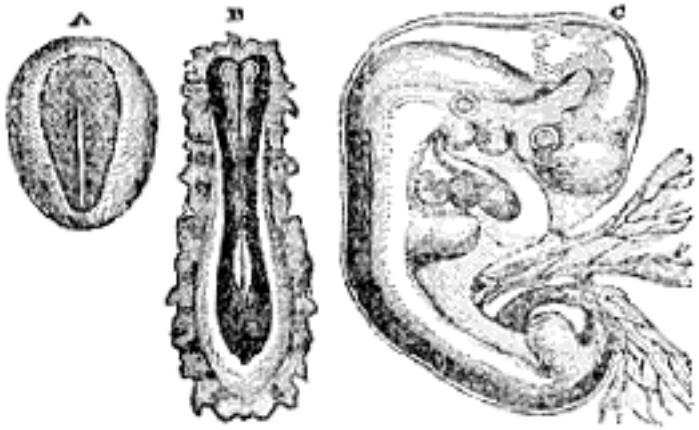


Fig. 14.–Earliest rudiment of the Dog. B. Rudiment further advanced, showing the foundations of the head, tail, and vertebral column. C. The very young puppy, with attached ends of the yelk-sac and allantois, and invested in the amnion.

Thus, at length, the young puppy assumes such a form as is shown in Fig. 14, C. In this condition it has a disproportionately large head, as dissimilar to that of a dog as the bud-like limbs are unlike his legs.

[87] The remains of the yelk, which have not yet been applied to the nutrition and growth of the young animal, are contained in a sac attached to the rudimentary intestine, and termed the yelk sac, or *umbilical vesicle.* Two membranous bags, intended to subserve respectively the protection and nutrition of the young creature, have been developed from the skin and from the under and hinder surface of the body; the former, the so-called *amnion,* is a sac filled with fluid, which invests the whole body of the embryo, and plays the part of a sort of water-bed for it; the other, termed the *allantois*, grows out, loaded with blood-vessels, from the ventral region, and eventually applying itself to the walls of the cavity, in which the developing organism is contained, enables these vessels to become the channel by which the stream of nutriment, required to supply the wants of the offspring, is furnished to it by the parent.

The structure which is developed by the interlacement of the vessels of the offspring with those of the parent, and by means of which the former is enabled to receive nourishment and to get rid of effete matters, is termed the *Placenta.*

It would be tedious, and it is unnecessary for my present purpose, to trace the process of development further; suffice it to say, that, by a long and gradual series of changes, the rudiment here depicted and

described, becomes a puppy, is [88] born, and then, by still slower and less perceptible steps, passes into the adult Dog.

There is not much apparent resemblance between a barn-door Fowl and the Dog who protects the farm-yard. Nevertheless the student of development finds, not only that the chick commences its existence as an egg, primarily identical, in all essential respects, with that of the Dog, but that the yelk of this egg undergoes division–that the primitive groove arises, and that the contiguous parts of the germ are fashioned, by precisely similar methods, into a young chick, which, at one stage of its existence, is so like the nascent Dog, that ordinary inspection would hardly distinguish the two.

The history of the development of any other vertebrate animal, Lizard, Snake, Frog, or Fish, tells the same story. There is always, to begin with, an egg having the same essential structure as that of the Dog:–the yelk of that egg always undergoes division, or *segmentation* as it is often called: the ultimate products of that segmentation constitute the building materials for the body of the young animal; and this is built up round a primitive groove, in the floor of which a notochord is developed. Furthermore, there is a period in which the young of all these animals resemble one another, not merely in outward form, but in all essentials of structure, so closely, that the [89] differences between them are inconsiderable, while, in their subsequent course they diverge more and more widely from one another. And it is a general law, that, the more closely any animals resemble one another in adult structure, the longer and the more intimately do their embryos resemble one another: so that, for example, the embryos of a Snake and of a Lizard remain like one another longer than do those of a Snake and of a Bird; and the embryo of a Dog and of a Cat remain like one another for a far longer period than do those of a Dog and a Bird; or of a Dog and an Opossum; or even than those of a Dog and a Monkey.

Thus the study of development affords a clear test of closeness of structural affinity, and one turns with impatience to inquire what results are yielded by the study of the development of Man. Is he something apart? Does he originate in a totally different way from Dog, Bird, Frog, and Fish, thus justifying those who assert him to have no place in nature and no real affinity with the lower world of animal life? Or does he originate in a similar germ, pass through the same slow and gradually progressive modifications, depend on the same contrivances for protection and nutrition, and finally enter the world by the help of the same mechanism? The reply is not doubtful for a moment, and has not been doubtful any time these thirty years. Without question, the mode of origin and the early stages of the development of man are [90] identical with those of the animals immediately below him in the scale:–without a doubt, in these respects, he is far nearer the Apes, than the Apes are to the Dog.

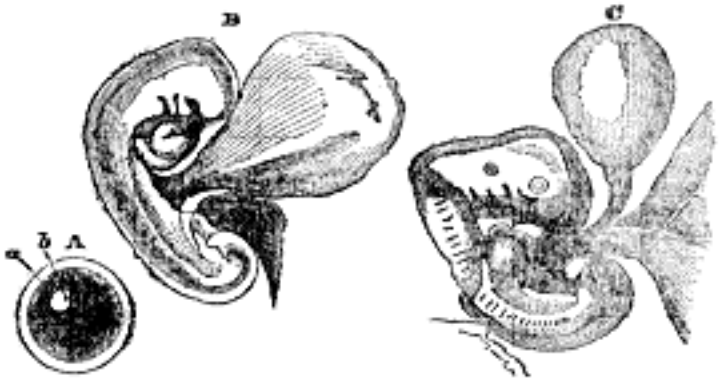


Fig. 15.–A. Human ovum (after Kölliker). *a.*. germinal vesicle. *b.* germinal spot. B. A very early condition of Man, with yelk-sac, allantois and amnion (original). C. A more advanced stage (after Kölliker), compare Fig. 14, C.

The Human ovum is about l/125th of an inch in diameter, and might be described in the same terms as that of the Dog, so that I need only refer to the figure illustrative (15 A) of its structure. It leaves the organ in which it is formed in a similar fashion and enters the organic chamber prepared for its reception in the same way, the conditions of its development being in all respects the same. It has not yet been possible (and only [91] by some rare chance can it ever be possible) to study the human ovum in so early a developmental stage as that of yelk division, but there is every reason to conclude that the changes it undergoes are identical with those exhibited by the ova of other vertebrated animals; for the formative materials of which the rudimentary human body is composed, in the earliest conditions in which it has been observed, are the same as those of other animals. Some of these earliest stages are figured below and, as will be seen, they are strictly comparable to the very early states of the Dog; the marvellous correspondence between the two which is kept up, even for some time, as development advances, becoming apparent by the simple comparison of the figures with those on page 86.

Indeed, it is very long before the body of the young human being can be readily discriminated from that of the young puppy; but, at a tolerably early period, the two become distinguishable by the different form of their adjuncts, the yelk-sac and the allantois. The former, in the Dog, becomes long and spindle-shaped, while in Man it remains spherical: the latter, in the Dog, attains an extremely large size, and the vascular processes which are developed from it and eventually give rise to the formation of the placenta (taking root, as it were, in the parental organism, so as to draw nourishment therefrom, as the root of a tree extracts it from the soil) are arranged in an en[92]circling zone, while in Man, the allantois remains comparatively small, and its vascular rootlets are eventually restricted to one disk-like spot. Hence, while the placenta of the Dog is like a girdle, that of Man has the cake-like form, indicated by the name of the organ.

But, exactly in those respects in which the developing Man differs from the Dog, he resembles the ape, which, like man, has a spheroidal yelk-sac and a discoidal, sometimes partially lobed, placenta. So that it is only quite in the later stages of development that the young human being presents marked differences from the young ape, while the latter departs as much from the dog in its development, as the man does.

Startling as the last assertion may appear to be, it is demonstrably true, and it alone appears to me sufficient to place beyond all doubt the structural unity of man with the rest of the animal world, and more particularly and closely with the apes.

Thus, identical in the physical processes by which he originates–identical in the early stages of his formation–identical in the mode of his nutrition before and after birth, with the animals which lie immediately below him in the scale–Man, if his adult and perfect structure be compared with theirs, exhibits, as might be expected, [93] a marvellous likeness of organization. He resembles them as they resemble one another–he differs from them as they differ from one another.–And, though these differences and resemblances cannot be weighed and measured, their value may be readily estimated; the scale or standard of judgment, touching that value being afforded and expressed by the system of classification of animals now current among zoologists.

A careful study of the resemblances and differences presented by animals has, in fact, led naturalists to arrange them into groups, or assemblages, all the members of each group presenting a certain amount of definable resemblance, and the number of points of similarity being smaller as the group is larger and *vice versa.* Thus, all creatures which agree only in presenting the few distinctive marks of animality form the *Kingdom* Animalia. The numerous animals which agree only in possessing the special characters of Vertebrates form one *Sub-Kingdom* of this Kingdom. Then the Sub-kingdom Vertebrata is subdivided into the five *Classes*, Fishes, Amphibians, Reptiles, Birds, and Mammals, and these into smaller groups called *Orders;* these into *Families* and *Genera;* while the last are finally broken up into the smallest assemblages, which are distinguished by the possession of constant, not-sexual, characters. These ultimate groups are Species.

[94] Every year tends to bring about a greater uniformity of opinion throughout the zoological world as to the limits and characters of these groups, great and small. At present, for example, no one has the least doubt regarding the characters of the classes Mammalia, Aves, or Reptilia; nor does the question arise whether any thoroughly well-known animal should be placed in one class or the other. Again, there is a very general agreement respecting the characters and limits of the orders of Mammals, and as to the animals which are structurally necessitated to take a place in one or another order.

No one doubts, for example, that the Sloth and the Ant-eater, the Kangaroo and the Opossum, the Tiger and the Badger, the Tapir and the Rhinoceros, are respectively members of the same orders. These successive pairs of animals may, and some do, differ from one another immensely, in such matters as the proportions and structure of their limbs; the number of their dorsal and lumbar vertebræ; the adaptation of their frames to climbing, leaping, or running; the number and form of their teeth; and the characters of their skulls and of the contained brain. But, with all these differences, they are so closely connected in all the more important and fundamental characters of their organization, and so distinctly separated by these same characters from other animals, that zoologists find it necessary to group them together [95] as members of one order. And if any new animal were discovered, and were found to present no greater difference from the Kangaroo or from the Opossum, for example, than these animals do from one another, the zoologist would not only be logically compelled to rank it in the same order with these, but

he would not think of doing otherwise.

Bearing this obvious course of zoological reasoning in mind, let us endeavour for a moment to disconnect our thinking selves from the mask of humanity; let us imagine ourselves scientific Saturnians, if you will, fairly acquainted with such animals as now inhabit the Earth, and employed in discussing the relations they bear to a new and singular "erect and featherless biped," which some enterprising traveller, overcoming the difficulties of space and gravitation, has brought from that distant planet for our inspection, well preserved, may be, in a cask of rum. We should all, at once, agree upon placing him among the mammalian vertebrates; and his lower jaw, his molars, and his brain, would leave no room for doubting the systematic position of the new genus among those mammals, whose young are nourished during gestation by means of a placenta, or what are called the "placental mammals."

Further, the most superficial study would at once convince us that, among the orders of placental mammals, neither the Whales, nor the [96] hoofed creatures, nor the Sloths and Ant-eaters, nor the carnivorous Cats, Dogs, and Bears, still less the Rodent Rats and Rabbits, or the Insectivorous Moles and Hedgehogs, or the Bats, could claim our *Homo,* as one of themselves.

There would remain then, but one order for comparison, that of the Apes (using that word in its broadest sense), and the question for discussion would narrow itself to this–is Man so different from any of these Apes that he must form an order by himself? Or does he differ less from them than they differ from one another, and hence must take his place in the same order with them?

Being happily free from all real, or imaginary, personal interest in the results of the inquiry thus set afoot, we should proceed to weigh the arguments on one side and on the other, with as much judicial calmness as if the question related to a new Opossum. We should endeavour to ascertain, without seeking either to magnify or diminish them, all the characters by which our new Mammal differed from the Apes; and if we found that these were of less structural value than those which distinguish certain members of the Ape order from others universally admitted to be of the same order, we should undoubtedly place the newly discovered tellurian genus with them.

I now proceed to detail the facts which seem to [97] me to leave us no choice but to adopt the last-mentioned course.

It is quite certain that the Ape which most nearly approaches man, in the totality of its organisation, is either the Chimpanzee or the Gorilla; and as it makes no practical difference, for the purposes of my present argument, which is selected for comparison, on the one hand, with Man, and on the other hand, with the rest of the Primates,[2] I shall select the latter (so far as its organisation is known)–as a brute now so celebrated in prose and verse, that all must have heard of him, and have formed some conception of his appearance. I shall take up as many of the most important points of difference between man and this remarkable creature, as the space at my disposal will allow me to discuss, and the necessities of the argument demand; and I shall inquire into the value and magnitude of these differences, when placed

side by side with those which separate the Gorilla from other animals of the same order.

In the general proportions of the body and limbs there is a remarkable difference between the Gorilla and Man, which at once strikes the [98] eye. The Gorilla's brain-case is smaller, its trunk larger, its lower limbs shorter, its upper limbs longer in proportion than those of Man.

I find that the vertebral column of a full-grown Gorilla, in the Museum of the Royal College of Surgeons, measures 27 inches along its anterior curvature, from the upper edge of the atlas, or first vertebra of the neck, to the lower extremity of the sacrum; that the arm, without the hand, is 31-1/2 inches long; that the leg, without the foot, is 26-1/2 inches long; that the hand is 9-3/4 inches long; the foot 11-1/4 inches long.

In other words, taking the length of the spinal column as 100, the arm equals 115, the leg 96, the hand 36, and the foot 41.

In the skeleton of a male Bosjesman, in the same collection, the proportions, by the same measurement, to the spinal column, taken as 100, are–the arm 78, the leg 110, the hand 26, and the foot 32. In a woman of the same race the arm is 83, and the leg 120, the hand and foot remaining the same. In a European skeleton I find the arm to be 80, the leg 117, the hand 26, the foot 35.

Thus the leg is not so different as it looks at first sight, in its proportion to the spine in the Gorilla and in the Man–being very slightly shorter than the spine in the former, and between 1/10 and 1/5 longer than the spine in the latter. The foot is longer and the hand much longer in [99] the Gorilla; but the great difference is caused by the arms, which are very much longer than the spine in the Gorilla, very much shorter than the spine in the Man.

The question now arises how are the other Apes related to the Gorilla in these respects–taking the length of the spine, measured in the same way, at 100. In an adult Chimpanzee, the arm is only 96, the leg 90, the hand 43, the foot 39–so that the hand and the leg depart more from the human proportion and the arm less, while the foot is about the same as in the Gorilla.

In the Orang, the arms are very much longer than in the Gorilla (122), while the legs are shorter (88); the foot is longer than the hand (52 and 48), and both are much longer in proportion to the spine.

In the other man-like Apes again, the Gibbons, these proportions are still further altered; the length of the arms being to that of the spinal column as 19 to 11; while the legs are also a third longer than the spinal column, so as to be longer than in Man, instead of shorter. The hand is half as long as the spinal column, and the foot, shorter than the hand, is about 5/11ths of the length of the spinal column.

Thus *Hylobates* is as much longer in the arms than the Gorilla, as the Gorilla is longer in the arms than Man; while, on the other hand, it is as much longer in the legs than the Man, as the [100] Man is longer in the legs than the Gorilla, so that it contains within itself the extremest deviations from the average

length of both pairs of limbs.[3]

The Mandrill presents a middle condition, the arms and legs being nearly equal in length, and both being shorter than the spinal column; while hand and foot have nearly the same proportions to one another and to the spine, as in Man.

In the Spider monkey (*Ateles*) the leg is longer than the spine, and the arm than the leg; and, finally, in that remarkable Lemurine form, the Indri (*Lichanotus*), the leg is about as long as the spinal column, while the arm is not more than 11/18 of its length; the hand having rather less and the foot rather more, than one third the length of the spinal column.

These examples might be greatly multiplied, but they suffice to show that, in whatever proportion of its limbs the Gorilla differs from Man, the other Apes depart still more widely from the Gorilla and that, consequently, such differences of proportion can have no ordinal value.

We may next consider the differences presented by the trunk, consisting of the vertebral column, or backbone, and the ribs and pelvis, or bony hip-basin, which are connected with it, in Man and in the Gorilla respectively.

[101] In Man, in consequence partly of the disposition of the articular surfaces of the vertebræ, and largely of the elastic tension of some of the fibrous bands, or ligaments, which connect these vertebræ together, the spinal column, as a whole, has an elegant S-like curvature, being convex forwards in the neck, concave in the back, convex in the loins, or lumbar region, and concave again in the sacral region; an arrangement which gives much elasticity to the whole backbone, and diminishes the jar communicated to the spine, and through it to the head, by locomotion in the erect position.

Furthermore, under ordinary circumstances, Man has seven vertebræ in his neck, which are called *cervical;* twelve succeed these, bearing ribs and forming the upper part of the back, whence they are termed *dorsal;* five lie in the loins, bearing no distinct, or free, ribs, and are called *lumbar;* five, united together into a great bone, excavated in front, solidly wedged in between the hip bones, to form the back of the pelvis, and known by the name of the *sacrum,* succeed these; and finally, three or four little more or less movable bones, so small as to be insignificant, constitute the *coccyx* or rudimentary tail.

In the Gorilla, the vertebral column is similarly divided into cervical, dorsal, lumbar, sacral, and coccygeal vertebræ, and the total number of cervical and dorsal vertebræ, taken together, is [102] the same as in Man; but the development of a pair of ribs to the first lumbar vertebra, which is an exceptional occurrence in Man, is the rule in the Gorilla; and hence, as lumbar are distinguished from dorsal vertebræ only by the presence or absence of free ribs, the seventeen "dorso-lumbar" vertebræ of the Gorilla are divided into thirteen dorsal and four lumbar, while in Man they are twelve dorsal and five lumbar.

Not only, however, does Man occasionally possess thirteen pair of ribs,[4] but the Gorilla sometimes has fourteen pairs, while an Orang-Utan skeleton in the Museum of the Royal College of Surgeons has twelve dorsal and five lumbar vertebræ, as in Man. Cuvier notes the same number in a *Hylobates.* On the other hand, among the lower Apes, many possess twelve dorsal and six or seven lumbar vertebræ;the Douroucouli has fourteen dorsal and eight lumbar, and a Lemur(*Stenops tardigradus*) has fifteen dorsal and nine lumbar vertebræ.

The vertebral column of the Gorilla, as a whole, differs from that of Man in the less marked char[103] acter of its curves, especially in the slighter convexity of the lumbar region. Nevertheless, the curves are present, and are quite obvious in young skeletons of the Gorilla and Chimpanzee which have been prepared without removal of the ligaments. In young Orangs similarly preserved on the other hand, the spinal column is either straight, or even concave forwards, throughout the lumbar region.

Whether we take these characters then, or such minor ones as those which are derivable from the proportional length of the spines of the cervical vertebræ, and the like, there is no doubt whatsoever as to the marked difference between Man and the Gorilla; but there is as little, that equally marked differences, of the very same order, obtain between the Gorilla and the lower Apes.

The Pelvis, or bony girdle of the hips, of Man is a strikingly human part of his organisation; the expanded haunch bones affording support for his viscera during his habitually erect posture, and giving space for the attachment of the great muscles which enable him to assume and to preserve that attitude. In these respects the pelvis of the Gorilla differs very considerably from his (Fig. 16). But go no lower than the Gibbon, and see how vastly more he differs from the Gorilla than the latter does from Man, even in this structure. Look at the flat, narrow haunch bones–the

[104]

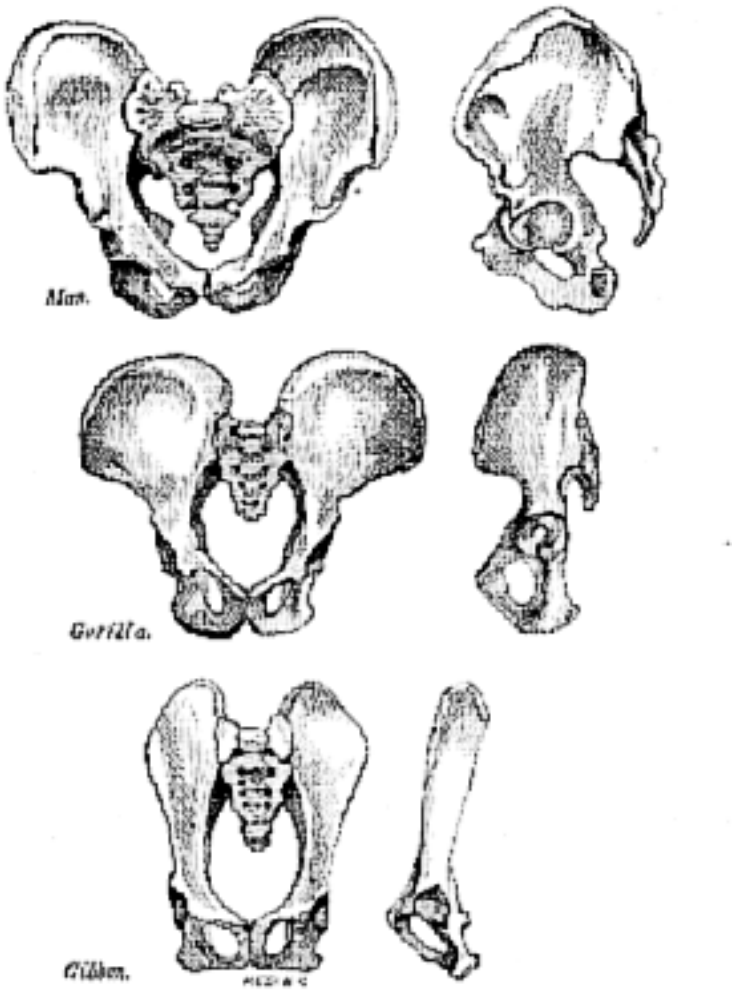


Fig. 16.–Front and side views of the bony pelvis of Man, the Gorilla and Gibbon: reduced from drawings and from nature, of the same absolute length, by Mr. Waterhouse Hawkins.

[105] long and narrow passage–the coarse, outwardly curved, ischiatic prominences on which the Gibbon habitually rests, and which are coated by the so-called "callosities," dense patches of skin, wholly absent in the Gorilla, in the Chimpanzee, and in the Orang, as in Man!

In the lower Monkeys and in the Lemurs the difference becomes more striking still, the pelvis acquiring an altogether quadrupedal character.

But now let us turn to a nobler and more characteristic organ–that by which the human frame seems to be, and indeed is, so strongly distinguished from all others,–I mean the skull. The differences between a Gorilla's skull and a Man's are truly immense (Fig. 17). In the former, the face, formed largely by the massive jaw-bones, predominates over the brain-case, or cranium proper: in the latter, the proportions of the two are reversed. In the Man, the occipital foramen, through which passes the great nervous cord connecting the brain with the nerves of the body, is placed just behind the centre of the base of the skull, which thus becomes evenly balanced in the erect posture; in the Gorilla, it lies in the posterior third of that base. In the Man, the surface of the skull is comparatively smooth, and the supraciliary ridges or brow prominences usually project but little–while, in the Gorilla, vast crests are developed upon the

skull, and the brow ridges overhang, the cavernous orbits, like great penthouses.

[106] Sections of the skulls, however, show that some of the apparent defects of the Gorilla's cranium arise, in fact, not so much from deficiency of braincase as from excessive development of the parts of the face. The cranial cavity is not ill-shaped, and the forehead is not truly flattened or very retreating, its really well-formed curve being simply disguised by the mass of bone which is built up against it (Fig. 17).

But the roofs of the orbits rise more obliquely into the cranial cavity, thus diminishing the space for the lower part of the anterior lobes of the brain, and the absolute capacity of the cranium is far less than that of Man. So far as I am aware, no human cranium belonging to an adult man has yet been observed with a less cubical capacity than 62 cubic inches, the smallest cranium observed in any race of men by Morton, measuring 63 cubic inches; while, on the other hand, the most capacious Gorilla skull yet measured has a content of not more than 34-1/2 cubic inches. Let us assume, for simplicity's sake, that the lowest Man's skull has twice the capacity of that of the highest Gorilla.[5]

[107] No doubt, this is a very striking difference, but it loses much of its apparent systematic value, when viewed by the light of certain other equally indubitable facts respecting cranial capacities.

The first of these is, that the difference in the volume of the cranial cavity of different races of mankind is far greater, absolutely, than that between the lowest Man and the highest Ape, while, relatively, it is about the same. For the largest human skull measured by Morton contained 114 cubic inches, that is to say, had very nearly double the capacity of the smallest; while its absolute preponderance, of 52 cubic inches–is far greater than that by which the lowest adult [108] male human cranium surpasses the largest of the Gorillas (62–34-1/2 = 27-1/2). Secondly, the adult crania of Gorillas which have as yet been measured differ among themselves by nearly one-third, the maximum capacity being 34.5 cubic inches, the minimum 24 cubic inches; and, thirdly, after making all due allowance for difference of size, the cranial capacities of some of the lower Apes fall nearly as much, relatively, below those of the higher Apes as the latter fall below Man.

Thus, even in the important matter of cranial capacity, Men differ more widely from one another than they do from the Apes; while the lowest Apes differ as much, in proportion, from the highest, as the latter does from Man. The last proposition is still better illustrated by the study of the modifications which other parts of the cranium undergo in the Simian series.

It is the large proportional size of the facial bones and the great projection of the jaws which confers upon the Gorilla's skull its small facial angle and brutal character.

But if we consider the proportional size of the facial bones to the skull proper only, the little *Chrysothrix* (Fig. 17) differs very widely from the Gorilla, and, in the same way, as Man does; while the Baboons (*Cynocephalus*) (Fig. 17) exaggerate the gross proportions of the muzzle of the great Anthropoid, so that its visage looks mild and human by comparison with theirs. The difference

[109]

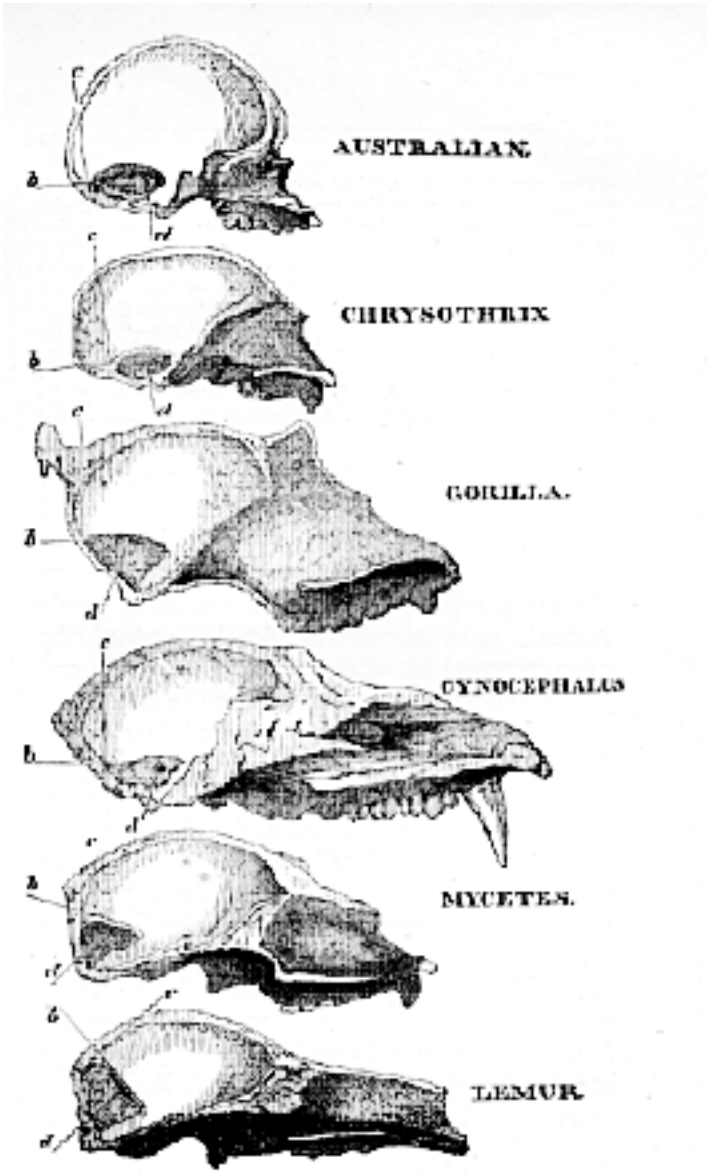


Fig. 17.–Sections of the skulls of Man and various Apes, [110] drawn so as to give the cerebral cavity the same length in each case, thereby displaying the varying proportions of the facial bones. The line *b* indicates the plane of the tentorium, which separates the cerebrum from the cerebellum; *d,* the axis of the occipital outlet of the skull. The extent of cerebral cavity behind *c,* which is a perpendicular erected on *b* at the point where the tentorium is attached posteriorly, indicates the degree to which the cerebrum overlaps the cerebellum–the space occupied by which is roughly indicated by the dark shading. In comparing these diagrams, it must be recollected, that figures on so small a scale as these simply exemplify the statements in the text, the proof of which is to be found in the objects themselves.

between the Gorilla and the Baboon is even greater than it appears at first sight; for the great facial mass of the former is largely due to a downward development of the jaws; an essentially human character, superadded upon that almost purely forward, essentially brutal, development of the same parts which characterises the Baboon, and yet more remarkably distinguishes the Lemur.

Similarly, the occipital foramen of *Mycetes* (Fig. 17), and still more of the Lemurs, is situated completely in the posterior face of the skull, or as much further back than that of the Gorilla, as that of the Gorilla is further back than that of Man; while, as if to render patent the futility of the attempt to base any broad classificatory distinction on such a character, the same group of Platyrhine, or American monkeys, to which the *Mycetes* belongs, contains the *Chrysothrix*, whose occipital foramen is situated far more forward than in any other ape, and nearly approaches the position it holds in Man.

[111] Again, the Orang's skull is as devoid of excessively developed supraciliary prominences as a Man's, though some varieties exhibit great crests elsewhere (See p. 25); and in some of the Cebine apes and in the *Chrysothrix*, the cranium is as smooth and rounded as that of Man himself.

What is true of these leading characteristics of the skull, holds good, as may be imagined, of all minor features; so that for every constant difference between the Gorilla's skull and the Man's, a similar constant difference of the same order (that is to say, consisting in excess or defect of the same quality) may be found between the Gorilla's skull and that of some other ape. So that, for the skull, no less than for the skeleton in general, the proposition holds good, that the differences between Man and the Gorilla are of smaller value than those between the Gorilla and some other Apes.

In connection with the skull, I may speak of the teeth–organs which have a peculiar classificatory value, and whose resemblances and differences of number, form, and succession, taken as a whole, are usually regarded as more trustworthy indicators of affinity than any others.

Man is provided with two sets of teeth–milk teeth and permanent teeth. The former consist of four incisors, or cutting teeth; two canines, or eyeteeth; and four molars or grinders, in each jaw, making twenty in all. The latter (Fig. 18) com[112]prise four incisors, two canines, four small grinders, called premolars or false molars, and six large grinders, or true molars in each jaw–making thirty-two in all. The internal incisors are larger than the external pair, in the upper jaw, smaller than the external pair, in the lower jaw. The crowns of the upper molars exhibit four cusps, or blunt-pointed elevations, and a ridge crosses the crown obliquely, from the inner, anterior cusp to the outer, posterior cusp (Fig. 18 m^2). The anterior lower molars have five cusps, three external and two internal. The premolars have two cusps, one internal and one external, of which the outer is the higher.

In all these respects the dentition of the Gorilla may be described in the same terms as that of Man; but in other matters it exhibits many and important differences (Fig. 18).

Thus the teeth of man constitute a regular and even series–without any break and without any marked projection of one tooth above the level of the rest; a peculiarity which, as Cuvier long ago showed, is shared by no other mammal save one–as different a creature from man as can well be imagined–namely, the long extinct *Anoplotherium.* The teeth of the Gorilla, on the contrary, exhibit a break, or interval, termed the *diastema*, in both jaws: in front of the eye-tooth, or between it and the outer incisor, in the upper jaw; behind the eyetooth, or between it and the front false molar, in the

[113]

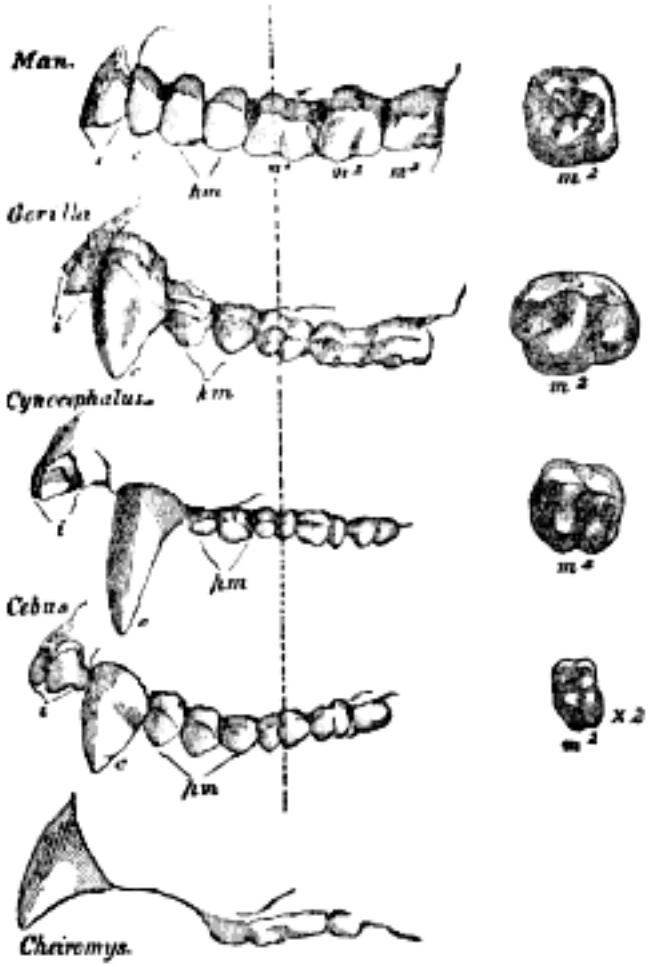


Fig. 18.–Lateral views of the same length, of the upper jaws of various Primates. *i*, incisors; *c*, canines; *pm*, pre-[114]molars; *m*, molars. A line is drawn through the first molar of *Man, Gorilla, Cynocephalus,* and *Cebus,* and the grinding surface of the second molar is shown in each, its anterior and internal angle being just above the *m* of m^2.

lower jaw. Into this break in the series, in each jaw, fits the canine of the opposite jaw; the size of the eye-tooth in the Gorilla being so great that it projects, like a tusk, far beyond the general level of the other teeth. The roots of the false molar teeth of the Gorilla, again, are more complex than in Man, and the proportional size of the molars is different. The Gorilla has the crown of the hindmost grinder of the lower jaw more complex, and the order of eruption of the permanent teeth is different; the permanent canines making their appearance before the second and third molars in Man, and after them in the Gorilla.

Thus, while the teeth of the Gorilla closely resemble those of Man in number, kind, and in the general pattern of their crowns, they exhibit marked differences from those of Man in secondary respects, such as relative size, number of fangs, and order of appearance.

But, if the teeth of the Gorilla be compared with those of an Ape, no further removed from it than a *Cynocephalus,* or Baboon, it will be found that differences and resemblances of the same order are

easily observable; but that many of the points in which the Gorilla resembles Man are those in which it differs from the Baboon; while [115] various respects in which it differs from Man are exaggerated in the *Cynocephalus.* The number and the nature of the teeth remain the same in the Baboon as in the Gorilla and in Man. But the pattern of the Baboon's upper molars is quite different from that described above (Fig. 18), the canines are proportionally longer and more knife-like; the anterior premolar in the lower jaw is specially modified; the posterior molar of the lower jaw is still larger and more complex than in the Gorilla.

Passing from the old-world Apes to those of the new world, we meet with a change of much greater importance than any of these. In such a genus as *Cebus*, for example (Fig. 18), it will be found that while in some secondary points, such as the projection of the canines and the diastema, the resemblance to the great ape is preserved; in other and most important respects, the dentition is extremely different. Instead of 20 teeth in the milk set, there are 24: instead of 32 teeth in the permanent set, there are 36, the false molars being increased from eight to twelve. And in form, the crowns of the molars are very unlike those of the Gorilla, and differ far more widely from the human pattern.

The Marmosets, on the other hand, exhibit the same number of teeth as Man and the Gorilla; but, notwithstanding this, their dentition is very different, for they have four more false molars, [116] like the other American monkeys–but as they have four fewer true molars, the total remains the same. And passing from the American apes to the Lemurs, the dentition becomes still more completely and essentially different from that of the Gorilla. The incisors begin to vary both in number and in form. The molars acquire, more and more, a many-pointed, insectivorous character, and in one Genus, the Aye-Aye (*Cheiromys*), the canines disappear, and the teeth completely simulate those of a Rodent (Fig. 18).

Hence it is obvious that, greatly as the dentition of the highest Ape differs from that of Man, it differs far more widely from that of the lower and lowest Apes.

Whatever part of the animal fabric–whatever series of muscles, whatever viscera might be selected for comparison–the result would be the same–the lower Apes and the Gorilla would differ more than the Gorilla and the Man. I cannot attempt in this place to follow out all these comparisons in detail, and indeed it is unnecessary I should do so. But certain real, or supposed, structural distinctions between man and the apes remain, upon which so much stress has been laid, that they require careful consideration, in order that the true value may be assigned to those which are real, and the emptiness of those which are fictitious may be exposed. I refer to the [117] characters of the hand, the foot, and the brain.

Man has been defined as the only animal possessed of two hands terminating his fore limbs, and of two feet ending his hind limbs, while it has been said that all the apes possess four hands; and he has been affirmed to differ fundamentally from all the apes in the characters of his brain, which alone, it has been strangely asserted and reasserted, exhibits the structures known to anatomists as the posterior lobe, the posterior cornu of the lateral ventricle, and the hippocampus minor.

That the former proposition should have gained general acceptance is not surprising–indeed, at first sight, appearances are much in its favour: but, as for the second, one can only admire the surpassing courage of its enunciator, seeing that it is an innovation which is not only opposed to generally and justly accepted doctrines, but which is directly negatived by the testimony of all original inquirers, who have specially investigated the matter: and that it neither has been, nor can be, supported by a single anatomical preparation. It would, in fact, be unworthy of serious refutation, except for the general and natural belief that deliberate and reiterated assertions must have some foundation.

Before we can discuss the first point with [118] advantage we must consider with some attention, and compare together, the structure of the human hand and that of the human foot, so that we may have distinct and clear ideas of what constitutes a hand and what a foot.

The external form of the human hand is familiar enough to every one. It consists of a stout wrist followed by a broad palm, formed of flesh, and tendons, and skin, binding together four bones, and dividing into four long and flexible digits, or fingers, each of which bears on the back of its last joint a broad and flattened nail. The longest cleft between any two digits is rather less than half as long as the hand. From the outer side of the base of the palm a stout digit goes off, having only two joints instead of three; so short, that it only reaches to a little beyond the middle of the first joint of the finger next it; and further remarkable by its great mobility, in consequence of which it can be directed outwards, almost at a right angle to the rest. This digit is called the "*pollex*" or thumb; and, like the others, it bears a flat nail upon the back of its terminal joint. In consequence of the proportions and mobility of the thumb, it is what is termed "opposable"; in other words, its extremity can, with the greatest ease, be brought into contact with the extremities of any of the fingers; a property upon which the possibility of our carrying into effect the conceptions of the mind so largely depends.

[119] The external form of the foot differs widely from that of the hand; and yet, when closely compared, the two present some singular resemblances. Thus the ankle corresponds in a manner with the wrist; the sole with the palm; the toes with the fingers; the great toe with the thumb. But the toes, or digits of the foot, are far shorter in proportion than the digits of the hand, and are less moveable, the want of mobility being most striking in the great toe–which, again, is very much larger in proportion to the other toes than the thumb to the fingers. In considering this point, however, it must not be forgotten that the civilized great toe, confined and cramped from childhood upwards, is seen to a great disadvantage, and that in uncivilized and barefooted people it retains a great amount of mobility, and even some sort of opposability. The Chinese boatmen are said to be able to pull an oar; the artisans of Bengal to weave, and the Carajas to steal fishhooks by its help; though, after all, it must be recollected that the structure of its joints and the arrangement of its bones, necessarily render its prehensile action far less perfect than that of the thumb.

But to gain a precise conception of the resemblances and differences of the hand and foot, and of the distinctive characters of each, we must look below the skin, and compare the bony framework and its motor apparatus in each (Fig. 19).

[120]

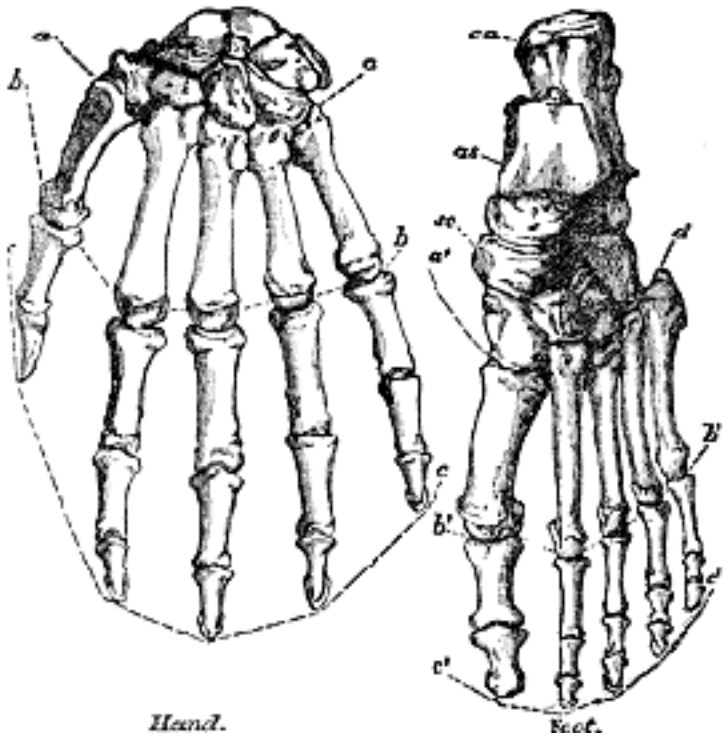


Fig. 19.–The skeleton of the Hand and Foot of Man reduced from Dr. Carter's drawings in Gray's *Anatomy*. The hand is drawn to a larger scale than the foot. The line *a a* in the hand indicates the boundary between the carpus and the metacarpus; *b b* that between the latter and the proximal phalanges; *c c* marks the ends of the distal phalanges. The line *a′ a′* in the foot indicates the boundary between the tarsus and metatarsus; *b′ b′* marks that between the metatarsus and the proximal phalanges; and *c′ c′* bounds the ends of the distal phalanges; *ca*, the calcaneum; *as*, the astragalus; *sc*, the scaphoid bone in the tarsus.

[121] The skeleton of the hand exhibits, in the region which we term the wrist, and which is technically called the *carpus*– two rows of closely fitted polygonal bones, four in each row, which are tolerably equal in size. The bones of the first row with the bones of the forearm, form the wrist joint, and are arranged side by side, no one greatly exceeding or overlapping the rest.

Three of the bones of the second row of the carpus bear the four long bones which support the palm of the hand. The fifth bone of the same character is articulated in a much more free and moveable manner than the others, with its carpal bone, and forms the base of the thumb. These are called *metacarpal* bones, and they carry the *phalanges,* or bones of the digits, of which there are two in the thumb, and three in each of the fingers.

The skeleton of the foot is very like that of the hand in some respects. Thus there are three phalanges in each of the lesser toes, and only two in the great toe, which answers to the thumb. There is a long bone, termed *metatarsal,* answering to the metacarpal, for each digit; and the *tarsus* which corresponds with the carpus, presents four short polygonal bones in a row, which correspond very closely with the four carpal bones of the second row of the hand. In other respects the foot differs very widely from the hand. Thus the great toe is the longest digit but one; and its [122] metatarsal is far less moveably articulated

with the tarsus than the metacarpal of the thumb with the carpus. But a far more important distinction lies in the fact that, instead of four more tarsal bones there are only three; and, that these three are not arranged side by side, or in one row. One of them, the *os calcis* or heel bone (*ca*), lies externally, and sends back the large projecting heel; another, the *astragalus* (*as*), rests on this by one face, and by another, forms, with the bones of the leg, the ankle joint; while a third face, directed forwards, is separated from the three inner tarsal bones of the row next the metatarsus by a bone called the *scaphoid*

(*sc*).

Thus there is a fundamental difference in the structure of the foot and the hand, observable when the carpus and the tarsus are contrasted: and there are differences of degree noticeable when the proportions and the mobility of the metacarpals and metatarsals, with their respective digits, are compared together.

The same two classes of differences become obvious when the muscles of the hand are compared with those of the foot.

Three principal sets of muscles, called "flexors," bend the fingers and thumb, as in clenching the fist, and three sets,–the extensors–extend them, as in straightening the fingers. These muscles are all "long muscles"; that is to say, the fleshy part of each, lying in and being fixed to the bones [123] of the arm, is, at the other end, continued into tendons, or rounded cords, which pass into the hand, and are ultimately fixed to the bones which are to be moved. Thus, when the fingers are bent, the fleshy parts of the flexors of the fingers, placed in the arm, contract, in virtue of their peculiar endowment as muscles; and pulling the tendinous cords, connecting with their ends, cause them to pull down the bones of the fingers towards the palm.

Not only are the principal flexors of the fingers and of the thumb long muscles, but they remain quite distinct from one another throughout their whole length.

In the foot, there are also three principal flexor muscles of the digits or toes, and three principal extensors; but one extensor and one flexor are short muscles; that is to say, their fleshy parts are not situated in the leg (which corresponds with the arm), but in the back and in the sole of the foot–regions which correspond with the back and the palm of the hand.

Again, the tendons of the long flexor of the toes, and of the long flexor of the great toe, when they reach the sole of the foot, do not remain distinct from one another, as the flexors in the palm of the hand do, but they become united and commingled in a very curious manner–while their united tendons receive an accessory muscle connected with the heel-bone.

[124] But perhaps the most absolutely distinctive character about the muscles of the foot is the existence of what is termed the *peronæus longus*, a long muscle fixed to the outer bone of the leg, and sending its tendon to the outer ankle, behind and below which it passes, and then crosses the foot obliquely to be attached to the base of the great toe. No muscle in the hand exactly corresponds with this, which is

eminently a foot muscle.

To resume–the foot of man is distinguished from his hand by the following absolute anatomical differences:–

1. By the arrangement of the tarsal bones.

2. By having a short flexor and a short extensor muscle of the digits.

3. By possessing the muscle termed *peronæus longus.*

And if we desire to ascertain whether the terminal division of a limb, in other Primates, is to be called a foot or a hand, it is by the presence or absence of these characters that we must be guided, and not by the mere proportions and greater or lesser mobility of the great toe, which may vary indefinitely without any fundamental alteration in the structure of the foot.

Keeping these considerations in mind, let us now turn to the limbs of the Gorilla. The terminal division of the fore limb presents no difficulty–bone for bone and muscle for muscle, are [125] found to be arranged essentially as in man, or with such minor differences as are found as varieties in man. The Gorilla's hand is clumsier, heavier, and has a thumb somewhat shorter in proportion than that of man; but no one has ever doubted it being a true hand.

At first sight, the termination of the hind limb of the Gorilla looks very hand-like, and as it is still more so in many of the lower apes, it is not wonderful that the appellation "Quadrumana," or four-handed creatures, adopted from the older anatomists[6] by Blumenbach, and unfortunately rendered current by Cuvier, should have gained such wide acceptance as a name for the Simian group. But the most cursory anatomical investigation at once proves that the resemblance of the so-called "hind hand" to a true hand, is only skin deep, and that, in all essential respects, the hind limb of the Gorilla is as truly terminated [126] by a foot as that of man. The tarsal bones, in all important circumstances of number, disposition, and form, resemble those of man (Fig. 20). The metatarsals and digits, on the other hand, are proportionally longer and more slender, while the great toe is not only proportionally shorter and weaker, but its metatarsal bone is united by a more moveable joint with the tarsus. At the same time, the foot is set more obliquely upon the leg than in man.

As to the muscles, there is a short flexor, a short extensor, and a *peronæus longus*, while the tendons of the long flexors of the great toe and of the other toes are united together and with an accessory fleshy bundle.

The hind limb of the Gorilla, therefore, ends in a true foot, with a very moveable great toe. It is a prehensile foot, indeed, but is in no sense a hand; it is a foot which differs from that of man not in any fundamental character, but in mere proportions, in the degree of mobility, and in the secondary arrangement of its parts.

It must not be supposed, however, because I speak of these differences as not fundamental, that I wish to underrate their value. They are important enough in their way, the structure of the foot being in strict correlation with that of the rest of the organism in each case. Nor can it be doubted that the greater division of physiological labour in Man, so that the function of support is [127] thrown wholly on the leg and foot, is an advance in organization of very great moment to him; but, after all, regarded anatomically, the resemblances between the foot of Man and the foot of the Gorilla are far more striking and important than the differences.

I have dwelt upon this point at length, because it is one regarding which much delusion prevails; but I might have passed it over without detriment to my argument, which only requires me to show that, be the differences between the hand and foot of Man and those of the Gorilla what they may–the differences between those of the Gorilla, and those of the lower Apes are much greater.

It is not necessary to descend lower in the scale than the Orang for conclusive evidence on this head.

The thumb of the Orang differs more from that of the Gorilla than the thumb of the Gorilla differs from that of Man, not only by its shortness, but by the absence of any special long flexor muscle. The carpus of the Orang, like that of most lower apes, contains nine bones, while in the Gorilla, as in Man and the Chimpanzee, there are only eight.

The Orang's foot (Fig. 20) is still more aberrant; its very long toes and short tarsus, short great toe, short and raised heel, great obliquity of articulation with the leg, and absence of a long flexor tendon to the great toe, separating it far [128] more widely from the foot of the Gorilla than the latter is separated from that of Man.

[128]

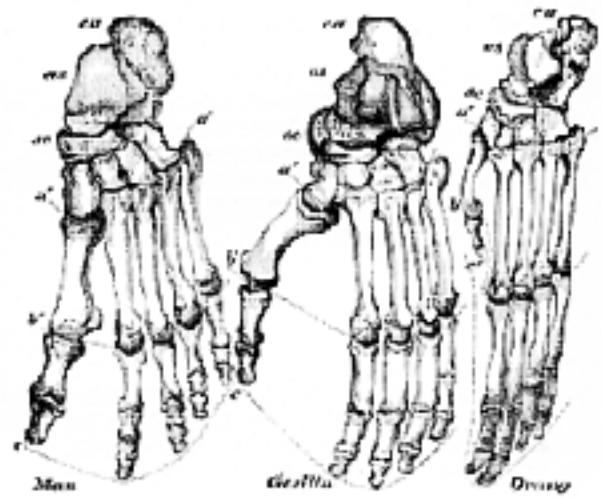


Fig. 20.–Foot of Man, Gorilla, and Orang-Utan of the same absolute length, to show the differences in proportion

of each. Letters as in Fig. 19. Reduced from original drawings by Mr. Waterhouse Hawkins.

But, in some of the lower apes, the hand and foot diverge still more from those of the Gorilla, than they do in the Orang. The thumb ceases to be opposable in the American monkeys; is reduced [129] to a mere rudiment covered by the skin in the Spider Monkey; and is directed forwards and armed with a curved claw like the other digits, in the Marmosets–so that, in all these cases, there can be no doubt but that the hand is more different from that of the Gorilla than the Gorilla's hand is from Man's.

And as to the foot, the great toe of the Marmoset is still more insignificant in proportion than that of the Orang–while in the Lemurs it is very large, and as completely thumb-like and opposable as in the Gorilla–but in these animals the second toe is often irregularly modified, and in some species the two principal bones of the tarsus, the *astragalus* and the *os calcis*, are so immensely elongated as to render the foot, so far, totally unlike that of any other mammal.

So with regard to the muscles. The short flexor of the toes of the Gorilla differs from that of Man by the circumstance that one slip of the muscle is attached, not to the heel bone, but to the tendons of the long flexors. The lower Apes depart from the Gorilla by an exaggeration of the same character, two, three, or more, slips becoming fixed to the long flexor tendons–or by a multiplication of the slips.–Again, the Gorilla differs slightly from Man in the mode of interlacing of the long flexor tendons: and the lower apes differ from the Gorilla in exhibiting yet other, sometimes very complex, arrangements of the same parts, and [130] occasionally in the absence of the accessory fleshy bundle.

Throughout all these modifications it must be recollected that the foot loses no one of its essential characters. Every Monkey and Lemur exhibits the characteristic arrangement of tarsal bones, possesses a short flexor and short extensor muscle, and a *peronæus longus.* Varied as the proportions and appearance of the organ may be, the terminal division of the hind limb remains, in plan and principle of construction, a foot, and never, in those respects, can be confounded with a hand.

Hardly any part of the bodily frame, then, could be found better calculated to illustrate the truth that the structural differences between Man and the highest Ape are of less value than those between the highest and the lower Apes, than the hand or the foot; and yet, perhaps, there is one organ the study of which enforces the same conclusion in a still more striking manner–and that is the Brain.

But before entering upon the precise question of the amount of difference between the Ape's brain and that of Man, it is necessary that we should clearly understand what constitutes a great, and what a small difference in cerebral structure; and we shall be best enabled to do this by a brief study of the chief modifications which the brain exhibits in the series of vertebrate animals.

[131] The brain of a fish is very small, compared with the spinal cord into which it is continued, and with the nerves which come off from it: of the segments of which it is composed–the olfactory lobes, the cerebral hemispheres, and the succeeding divisions–no one predominates so much over the rest as to obscure or cover them; and the so-called optic lobes are, frequently, the largest masses of all. In

Reptiles, the mass of the brain, relatively to the spinal cord, increases and the cerebral hemispheres begin to predominate over the other parts; while in Birds this predominance is still more marked. The brain of the lowest Mammals, such as the duck-billed Platypus and the Opossums and Kangaroos, exhibits a still more definite advance in the same direction. The cerebral hemispheres have now so much increased in size as, more or less, to hide the representatives of the optic lobes, which remain comparatively small, so that the brain of a Marsupial is extremely different from that of a Bird, Reptile, or Fish. A step higher in the scale, among the placental Mammals, the structure of the brain acquires a vast modification–not that it appears much altered externally, in a Rat or in a Rabbit, from what it is in a Marsupial–nor that the proportions of its parts are much changed, but an apparently new structure is found between the cerebral hemispheres, connecting them together, as what is called the "great commissure" or "corpus [132] callosum." The subject requires careful re-investigation, but if the currently received statements are correct, the appearance of the "corpus callosum" in the placental mammals is the greatest and most sudden modification exhibited by the brain in the whole series of vertebrated animals–it is the greatest leap anywhere made by Nature in her brain work. For the two halves of the brain being once thus knit together, the progress of cerebral complexity is traceable through a complete series of steps from the lowest Rodent, or Insectivore, to Man; and that complexity consists, chiefly, in the disproportionate development of the cerebral hemispheres and of the cerebellum, but especially of the former, in respect to the other parts of the brain.

In the lower placental mammals, the cerebral hemispheres leave the proper upper and posterior face of the cerebellum completely visible, when the brain is viewed from above; but, in the higher forms, the hinder part of each hemisphere, separated only by the tentorium (p. 137) from the anterior face of the cerebellum, inclines backwards and downwards, and grows out, as the so-called "posterior lobe," so as at length to overlap and hide the cerebellum. In all Mammals, each cerebral hemisphere contains a cavity which is termed the "ventricle"; and as this ventricle is prolonged, on the one hand, forwards, and on the other downwards, into the substance of the hemi[133]sphere, it is said to have two horns or "cornua," an "anterior cornu," and a "descending cornu." When the posterior lobe is well developed, a third prolongation of the ventricular cavity extends into it, and is called the "posterior cornu."

In the lower and smaller forms of placental Mammals the surface of the cerebral hemispheres is either smooth or evenly rounded, or exhibits a very few grooves, which are technically termed "sulci," separating ridges or "convolutions" of the substance of the brain; and the smaller species of all orders tend to a similar smoothness of brain. But, in the higher orders, and especially the larger members of these orders, the grooves, or sulci, become extremely numerous, and the intermediate convolutions proportionately more complicated in their meanderings, until, in the Elephant, the Porpoise, the higher Apes, and Man, the cerebral surface appears a perfect labyrinth of tortuous foldings.

Where a posterior lobe exists and presents its customary cavity–the posterior cornu–it commonly happens that a particular sulcus appears upon the inner and under surface of the lobe, parallel with and beneath the floor of the cornu–which is, as it were, arched over the roof of the sulcus. It is as if the groove had been formed by indenting the floor of the posterior horn from without with a blunt instrument, so that the floor should rise as a convex eminence. Now this [134] eminence is what has been termed the "Hippocampus minor;" the "Hippocampus major" being a larger eminence in the floor

of the descending cornu. What may be the functional importance of either of these structures we know not.

As if to demonstrate, by a striking example, the impossibility of erecting any cerebral barrier between man and the apes, Nature has provided us, in the latter animals, with an almost complete series of gradations from brains little higher than that of a Rodent, to brains little lower than that of Man. And it is a remarkable circumstance, that though, so far as our present knowledge extends, there is one true structural break in the series of forms of Simian brains, this hiatus does not lie between Man and the man-like apes, but between the lower and the lowest Simians; or, in other words, between the old and new world apes and monkeys, and the Lemurs. Every Lemur which has yet been examined, in fact, has its cerebellum partially visible from above, and its posterior lobe, with the contained posterior cornu and hippocampus minor, more or less rudimentary. Every Marmoset, American monkey, old world monkey, Baboon, or Man-like ape, on the contrary, has its cerebellum entirely hidden, posteriorly, by the cerebral lobes, and possesses a large posterior cornu, with a well-developed hippocampus minor.

[135] In many of these creatures, such as the Saimiri (*Chrysothrix*), the cerebral lobes overlap and extend much further behind the cerebellum, in proportion, than they do in man (Fig. 17)–and it is quite certain that, in all, the cerebellum is completely covered behind, by well developed posterior lobes. The fact can be verified by every one who possesses the skull of any old or new world monkey. For, inasmuch as the brain in all mammals completely fills the cranial cavity, it is obvious that a cast of the interior of the skull will reproduce the general form of the brain, at any rate with such minute and, for the present purpose, utterly unimportant differences as may result from the absence of the enveloping membranes of the brain in the dry skull. But if such a cast be made in plaster, and compared with a similar cast of the interior of a human skull, it will be obvious that the cast of the cerebral chamber, representing the cerebrum of the ape, as completely covers over and overlaps the cast of the cerebellar chamber, representing the cerebellum, as it does in the man (Fig. 21). A careless observer, forgetting that a soft structure like the brain loses its proper shape the moment it is taken out of the skull, may indeed mistake the uncovered condition of the cerebellum of an extracted and distorted brain for the natural relations of the parts; but his error must become patent even to himself if he try to replace the brain within the cranial chamber. To

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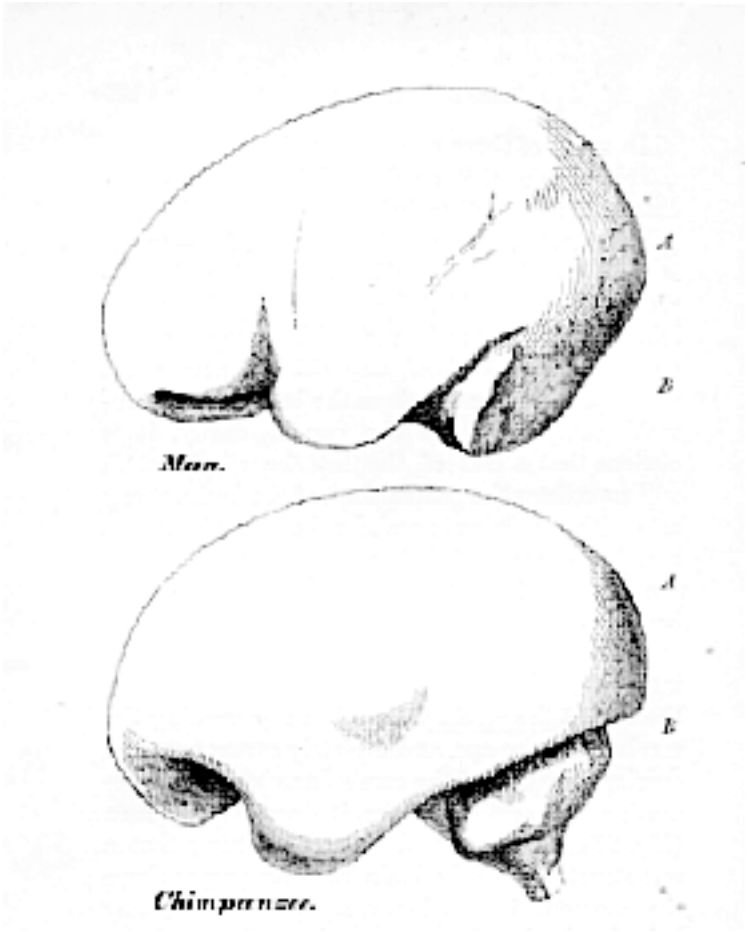

Fig. 21.–Drawings of the internal casts of a Man's and Chimpanzee's skull, of the same absolute length, and placed in corresponding positions. *A.* Cerebrum; *B.* Cerebellum. The former drawing is taken from a cast in the Museum of the Royal College of Surgeons, the latter from the photograph of the cast of a Chimpanzee's skull, which illustrates the paper by Mr. Marshall "On the Brain of the Chimpanzee" in the [137] *Natural History Review* for July, 1861. The sharper definition of the lower edge of the cast of the cerebral chamber in the Chimpanzee arises from the circumstance that the tentorium remained in that skull and not in the Man's. The cast more accurately represents the brain in the Chimpanzee than in the Man; and the great backward projection of the posterior lobes of the cerebrum of the former, beyond the cerebellum, is conspicuous.

suppose that the cerebellum of an ape is naturally uncovered behind is a miscomprehension comparable only to that of one who should imagine that a man's lungs always occupy but a small portion of the thoracic cavity, because they do so when the chest is opened, and their elasticity is no longer neutralized by the pressure of the air.

And the error is the less excusable, as it must become apparent to every one who examines a section of the skull of any ape above a Lemur, without taking the trouble to make a cast of it. For there is a very marked groove in every such skull, as in the human skull–which indicates the line of attachment of what is termed the *tentorium*–a sort of parchment-like shelf, or partition, which, in the recent state, is interposed between the cerebrum and cerebellum, and prevents the former from pressing upon the latter. (See Fig. 17.)

This groove, therefore, indicates the line of separation between that part of the cranial cavity which contains the cerebrum, and that which contains the cerebellum; and as the brain exactly fills the cavity of the skull, it is obvious that the relations of these two parts of the cranial cavity [138] at once informs us of the relations of their contents. Now in man, in all the old world, and in all the new world Simiæ, with one exception, when the face is directed forwards, this line of attachment of the tentorium, or impression for the lateral sinus, as it is technically called, is nearly horizontal, and the cerebral chamber invariably overlaps or projects behind the cerebellar chamber. In the Howler Monkey or *Mycetes* (see Fig. 17), the line passes obliquely upwards and backwards, and the cerebral overlap is almost nil; while in the Lemurs, as in the lower mammals, the line is much more inclined in the same direction, and the cerebellar chamber projects considerably beyond the cerebral.

When the gravest errors respecting points so easily settled as this question respecting the posterior lobes, can be authoritatively propounded, it is no wonder that matters of observation, of no very complex character, but still requiring a certain amount of care, should have fared worse. Any one who cannot see the posterior lobe in an ape's brain is not likely to give a very valuable opinion respecting the posterior cornu or the hippocampus minor. If a man cannot see a church, it is preposterous to take his opinion about its altar-piece or painted window–so that I do not feel bound to enter upon any discussion of these points, but content myself with assuring the reader that the posterior cornu and the hippocampus minor, [139] have now been seen–usually, at least as well developed as in man, and often better–not only in the Chimpanzee, the Orang, and the Gibbon, but in all the genera of the old world baboons and monkeys, and in most of the new world forms, including the Marmosets.

In fact, all the abundant and trustworthy evidence (consisting of the results of careful investigations directed to the determination of these very questions, by skilled anatomists) which we now possess, leads to the conviction that, so far from the posterior lobe, the posterior cornu, and the hippocampus minor, being structures peculiar to and characteristic of man, as they have been over and over again asserted to be, even after the publication of the clearest demonstration of the reverse, it is precisely these structures which are the most marked cerebral characters common to man with the apes. They are among the most distinctly Simian peculiarities which the human organism exhibits.

As to the convolutions, the brains of the apes exhibit every stage of progress, from the almost smooth brain of the Marmoset, to the Orang and the Chimpanzee, which fall but little below Man. And it is most remarkable that, as soon as all the principal sulci appear, the pattern according to which they are arranged is identical with that of the corresponding sulci of man. The surface of the brain of a monkey exhibits a sort of [140] skeleton map of man's, and in the man-like apes the details become more and more filled in, until it is only in minor characters, such as the greater excavation of the anterior lobes, the constant presence of fissures usually absent in man, and the different disposition and proportions of some convolutions, that the Chimpanzee's or the Orang's brain can be structurally distinguished from Man's.

So far as cerebral structure goes, therefore, it is clear that Man differs less from the Chimpanzee or the Orang, than these do even from the Monkeys, and that the difference between the brains of the Chimpanzee and of Man is almost insignificant, when compared with that between the Chimpanzee

brain and that of a Lemur.

It must not be overlooked, however, that there is a very striking difference in absolute mass and weight between the lowest human brain and that of the highest ape–a difference which is all the more remarkable when we recollect that a full-grown Gorilla is probably pretty nearly twice as heavy as a Bosjesman, or as many an European woman. It may be doubted whether a healthy human adult brain ever weighed less than thirty-one or two ounces, or that the heaviest Gorilla brain has exceeded twenty ounces.

This is a very noteworthy circumstance, and doubtless will one day help to furnish an explanation of the great gulf which intervenes between the

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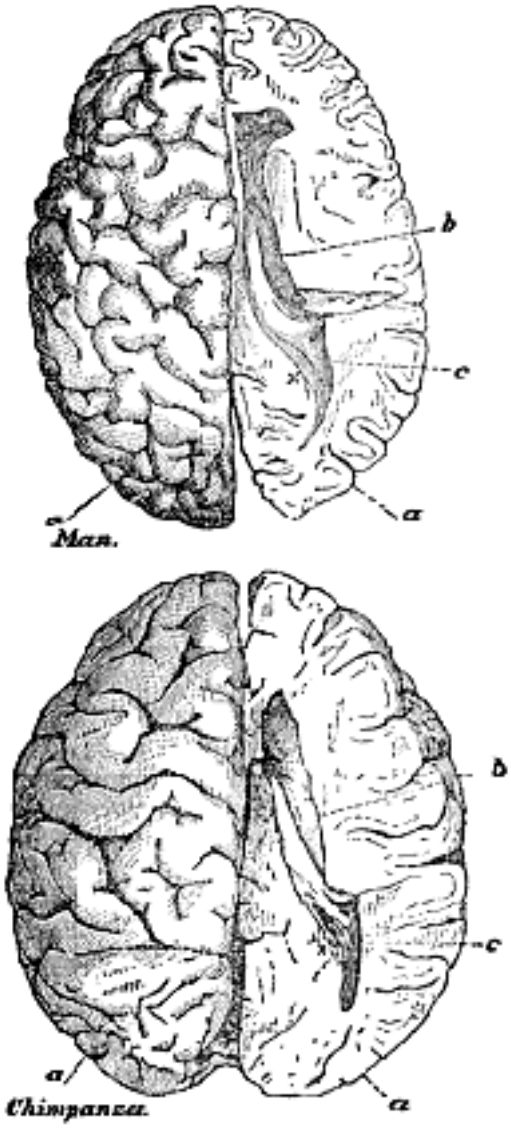

Fig. 22.–Drawings of the cerebral hemisphere of a Man [142] and of a Chimpanzee of the same length, in order to show the relative proportions of the parts: the former taken from a specimen, which Mr. Flower, Conservator

of the Museum of the Royal College of Surgeons, was good enough to dissect for me; the latter, from the photograph of a similarly dissected Chimpanzee's brain, given in Mr. Marshall's paper above referred to. *a*, posterior lobe; *b*, lateral ventricle; *c*, posterior cornu; *x*, the hippocampus minor.

lowest man and the highest ape in intellectual power;[7] but it has little systematic value, for the simple reason that, as may be concluded from what has been already said respecting cranial capacity, the difference in weight of brain between the highest and the lowest men is far greater, both [143] relatively and absolutely, than that between the lowest man and the highest ape. The latter, as has been seen, is represented by, say twelve, ounces of cerebral substance absolutely, or by 32:20 relatively; but as the largest recorded human brain weighed between 65 and 66 ounces, the former difference is represented by more than 33 ounces absolutely, or by 65:32 relatively. Regarded systematically, the cerebral differences of man and apes, are not of more than generic value; his [144] Family distinction resting chiefly on his dentition, his pelvis, and his lower limbs.

Thus, whatever system of organs be studied, the comparison of their modifications in the ape series leads to one and the same result–that the structural differences which separate Man from the Gorilla and the Chimpanzee are not so great as those which separate the Gorilla from the lower apes.

But in enunciating this important truth I must guard myself against a form of misunderstanding, which is very prevalent. I find, in fact, that those who endeavour to teach what nature so clearly shows us in this matter, are liable to have their opinions misrepresented and their phraseology garbled, until they seem to say that the structural differences between man and even the highest apes are small and insignificant. Let me take this opportunity then of distinctly asserting, on the contrary, that they are great and significant; that every bone of a Gorilla bears marks by which it might be distinguished from the corresponding bone of a Man; and that, in the present creation, at any rate, no intermediate link bridges over the gap between *Homo* and *Troglodytes.*

It would be no less wrong than absurd to deny the existence of this chasm; but it is at least equally wrong and absurd to exaggerate its magnitude, and, resting on the admitted fact of its [145] existence, to refuse to inquire whether it is wide or narrow. Remember, if you will, that there is no existing link between Man and the Gorilla, but do not forget that there is a no less sharp line of demarcation, a no less complete absence of any transitional form, between the Gorilla and the Orang, or the Orang and the Gibbon. I say, not less sharp, though it is somewhat narrower. The structural differences between Man and the Manlike apes certainly justify our regarding him as constituting a family apart from them; though, inasmuch as he differs less from them than they do from other families of the same order, there can be no justification for placing him in a distinct order.

And thus the sagacious foresight of the great lawgiver of systematic zoology, Linnæus, becomes justified, and a century of anatomical research brings us back to his conclusion, that man is a member of the same order (for which the Linnæan term Primates ought to be retained) as the Apes and Lemurs. This order is now divisible into seven families, of about equal systematic value: the first, the Anthropini, contains Man alone; the second, the Catarhini, embraces the old world apes; the third, the Platyrhini, all

new world apes, except the Marmosets; the fourth, the Arctopithecini, contains the Marmosets; the fifth, the Lemurini, the Lemurs–from which *Cheiromys* should probably be excluded to form a [146] sixth distinct family, the Cheiromyini; while the seventh, the Galeopithecini, contains only the flying Lemur *Galeopithecus*,– a strange form which almost touches on the Bats, as the *Cheiromys* puts on a Rodent clothing, and the Lemurs simulate Insectivora.

Perhaps no order of mammals presents us with so extraordinary a series of gradations as this–leading us insensibly from the crown and summit of the animal creation down to creatures, from which there is but a step, as it seems, to the lowest, smallest, and least intelligent of the placental Mammalia. It is as if nature herself had foreseen the arrogance of man, and with Roman severity had provided that his intellect by its very triumphs, should call into prominence the slaves, admonishing the conqueror that he is but dust.

These are the chief facts, this the immediate conclusion from them to which I adverted in the commencement of this Essay. The facts, I believe, cannot be disputed; and if so, the conclusion appears to me to be inevitable.

But if Man be separated by no greater structural barrier from the brutes than they are from one another–then it seems to follow that if any process of physical causation can be discovered by which the genera and families of ordinary animals have been produced, that process of causation is [147] amply sufficient to account for the origin of Man. In other words, if it could be shown that the Marmosets, for example, have arisen by gradual modification of the ordinary Platyrhini, or that both Marmosets and Platyrhini are modified ramifications of a primitive stock–then, there would be no rational ground for doubting that man might have originated, in the one case, by the gradual modification of a man-like ape; or, in the other case, as a ramification of the same primitive stock as those apes.

At the present moment, but one such process of physical causation has any evidence in its favour; or, in other words, there is but one hypothesis regarding the origin of species of animals in general which has any scientific existence–that propounded by Mr. Darwin. For Lamarck, sagacious as many of his views were, mingled them with so much that was crude and even absurd, as to neutralize the benefit which his originality might have effected, had he been a more sober and cautious thinker; and though I have heard of the announcement of a formula touching "the ordained continuous becoming of organic forms," it is obvious that it is the first duty of a hypothesis to be intelligible, and that a qua-quâ-versal proposition of this kind, which may be read backwards, or forwards, or sideways, with exactly the same amount of signification, does not really exist, though it may seem to do so.

[148] At the present moment, therefore, the question of the relation of man to the lower animals resolves itself, in the end, into the larger question of the tenability, or untenability, of Mr. Darwin's views. But here we enter upon difficult ground, and it behoves us to define our exact position with the greatest care.

It cannot be doubted, I think, that Mr. Darwin has satisfactorily proved that what he terms selection, or selective modification, must occur, and does occur, in nature; and he has also proved to superfluity that

such selection is competent to produce forms as distinct, structurally, as some genera even are. If the animated world presented us with none but structural differences, I should have no hesitation in saying that Mr. Darwin had demonstrated the existence of a true physical cause, amply competent to account for the origin of living species, and of man among the rest.

But, in addition to their structural distinctions, the species of animals and plants, or at least a great number of them, exhibit physiological characters–what are known as distinct species, structurally, being for the most part either altogether incompetent to breed one with another; or if they breed, the resulting mule, or hybrid, is unable to perpetuate its race with another hybrid of the same kind.

A true physical cause is, however, admitted to be such only on one condition–that it shall [149] account for all the phenomena which come within the range of its operation. If it is inconsistent with any one phenomenon, it must be rejected; if it fails to explain any one phenomenon, it is so far weak, so far to be suspected; though it may have a perfect right to claim provisional acceptance.

Now, Mr. Darwin's hypothesis is not, so far as I am aware, inconsistent with any known biological fact; on the contrary, if admitted, the facts of Development, of Comparative Anatomy, of Geographical Distribution, and of Palæontology, become connected together, and exhibit a meaning such as they never possessed before; and I, for one, am fully convinced, that if not precisely true, that hypothesis is as near an approximation to the truth as, for example, the Copernican hypothesis was to the true theory of the planetary motions.

But, for all this, our acceptance of the Darwinian hypothesis must be provisional so long as one link in the chain of evidence is wanting; and so long as all the animals and plants certainly produced by selective breeding from a common stock are fertile, and their progeny are fertile with one another, that link will be wanting. For, so long, selective breeding will not be proved to be competent to do all that is required of it to produce natural species.

I have put this conclusion as strongly as possible before the reader, because the last posi[150]tion in which I wish to find myself is that of an advocate for Mr. Darwin's, or any other views; if by an advocate is meant one whose business it is to smooth over real difficulties, and to persuade where he cannot convince.

In justice to Mr. Darwin, however, it must be admitted that the conditions of fertility and sterility are very ill understood, and that every day's advance in knowledge leads us to regard the hiatus in his evidence as of less and less importance, when set against the multitude of facts which harmonize with, or receive an explanation from, his doctrines.

I adopt Mr. Darwin's hypothesis, therefore, subject to the production of proof that physiological species may be produced by selective breeding; just as a physical philosopher may accept the undulatory theory of light, subject to the proof of the existence of the hypothetical ether; or as the chemist adopts the atomic theory, subject to the proof of the existence of atoms; and for exactly the same reasons, namely,

that it has an immense amount of prima facie probability: that it is the only means at present within reach of reducing the chaos of observed facts to order; and lastly, that it is the most powerful instrument of investigation which has been presented to naturalists since the invention of the natural system of classification, and the commencement of the systematic study of embryology.

[151] But even leaving Mr. Darwin's views aside, the whole analogy of natural operations furnishes so complete and crushing an argument against the intervention of any but what are termed secondary causes, in the production of all the phenomena of the universe; that, in view of the intimate relations between Man and the rest of the living world, and between the forces exerted by the latter and all other forces, I can see no excuse for doubting that all are co-ordinated terms of Nature's great progression, from the formless to the formed–from the inorganic to the organic–from blind force to conscious intellect and will.

Science has fulfilled her function when she has ascertained and enunciated truth; and were these pages addressed to men of science only, I should now close this Essay, knowing that my colleagues have learned to respect nothing but evidence, and to believe that their highest duty lies in submitting to it, however it may jar against their inclinations.

But desiring, as I do, to reach the wider circle of the intelligent public, it would be unworthy cowardice were I to ignore the repugnance with which the majority of my readers are likely to meet the conclusions to which the most careful and conscientious study I have been able to give to this matter, has led me.

On all sides I shall hear the cry–"We are men [152] and women, not a mere better sort of apes, a little longer in the leg, more compact in the foot, and bigger in brain than your brutal Chimpanzees and Gorillas. The power of knowledge–the conscience of good and evil–the pitiful tenderness of human affections, raise us out of all real fellowship with the brutes, however closely they may seem to approximate us."

To this I can only reply that the exclamation would be most just and would have my own entire sympathy, if it were only relevant. But, it is not I who seek to base Man's dignity upon his great toe, or insinuate that we are lost if an Ape has a hippocampus minor. On the contrary, I have done my best to sweep away this vanity. I have endeavoured to show that no absolute structural line of demarcation, wider than that between the animals which immediately succeed us in the scale, can be drawn between the animal world and ourselves; and I may add the expression of my belief that the attempt to draw a psychical distinction is equally futile, and that even the highest faculties of feeling and of intellect begin to germinate in lower forms of life.[8] At the same [153] time, no one is more strongly convinced than I am of the vastness of the gulf between civilized man and the brutes; or is more certain that whether *from* them or not, he is assuredly not *of* them. No one is less disposed to think lightly of the present dignity, or desparingly of the future hopes, of the only consciously intelligent denizen of this world.

We are indeed told by those who assume authority in these matters, that the two sets of opinions are incompatible, and that the belief in the unity of origin of man and brutes involves the brutalization and

degradation of the former. But is this really so? Could not a sensible child confute by obvious arguments, the shallow rhetoricians who would force this conclusion upon us? Is it, indeed, true, that the Poet, or the Philosopher, or the Artist whose genius is the glory of his age, is degraded from his high estate by the [154] undoubted historical probability, not to say certainty, that he is the direct descendant of some naked and bestial savage, whose intelligence was just sufficient to make him a little more cunning than the Fox, and by so much more dangerous than the Tiger? Or is he bound to howl and grovel on all fours because of the wholly unquestionable fact, that he was once an egg, which no ordinary power of discrimination could distinguish from that of a Dog? Or is the philanthropist, or the saint, to give up his endeavours to lead a noble life, because the simplest study of man's nature reveals, at its foundations, all the selfish passions, and fierce appetites of the merest quadruped? Is mother-love vile because a hen shows it, or fidelity base because dogs possess it?

The common sense of the mass of mankind will answer these questions without a moment's hesitation. Healthy humanity, finding itself hard pressed to escape from real sin and degradation, will leave the brooding over speculative pollution to the cynics and the "righteous overmuch" who, disagreeing in everything else, unite in blind insensibility to the nobleness of the visible world, and in inability to appreciate the grandeur of the place Man occupies therein.

Nay more, thoughtful men, once escaped from the blinding influences of traditional prejudice, will find in the lowly stock whence Man has sprung, the best evidence of the splendour of his [155] capacities; and will discern in his long progress through the Past, a reasonable ground of faith in his attainment of a nobler Future.

They will remember that in comparing civilised man with the animal world, one is as the Alpine traveller, who sees the mountains soaring into the sky and can hardly discern where the deep shadowed crags and roseate peaks end, and where the clouds of heaven begin. Surely the awestruck voyager may be excused if, at first, he refuses to believe the geologist, who tells him that these glorious masses are, after all, the hardened mud of primeval seas, or the cooled slag of subterranean furnaces–of one substance with the dullest clay, but raised by inward forces to that place of proud and seemingly inaccessible glory.

But the geologist is right; and due reflection on his teachings, instead of diminishing our reverence and our wonder, adds all the force of intellectual sublimity to the mere æsthetic intuition of the uninstructed beholder.

And after passion and prejudice have died away, the same result will attend the teachings of the naturalist respecting that great Alps and Andes of the living world–Man. Our reverence for the nobility of manhood will not be lessened by the knowledge that Man is, in substance and in structure, one with the brutes; for, he alone possesses the marvellous endowment of intelligible and rational speech, whereby, in the secular period [156] of his existence, he has slowly accumulated and organised the experience which is almost wholly lost with the cessation of every individual life in other animals; so that, now, he stands raised upon it as on a mountain top, far above the level of his humble fellows, and

transfigured from his grosser nature by reflecting, here and there, a ray from the infinite source of truth.

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[1] It will be understood that, in the preceding Essay, I have selected for notice from the vast mass of papers which have been written upon the man-like Apes, only those which seem to me to be of special moment.

[2] We are not at present thoroughly acquainted with the brain of the Gorilla, and therefore, in discussing cerebral characters, I shall take that of the Chimpanzee as my highest term among the Apes.

[3] See the figures of the skeletons of four anthropoid apes and of man, drawn to scale, p. 76.

[4] "More than once," says Peter Camper, "have I met with more than six lumbar vertebræ in man. ... Once I found thirteen ribs and four lumbar vertebræ." Fallopius noted thirteen pair of ribs and only four lumbar vertebræ, and Eustachius once found eleven dorsal vertebræ and six lumbar vertebræ–*Œuevres de Pierre Camper*, T. 1, p. 42. As Tyson states, his "Pygmie" had thirteen pair of ribs and five lumbar vertebræ. The question of the curves of the spinal column in the Apes requires further investigation.

[5] It has been affirmed that Hindoo crania sometimes contain as little as 27 ounces of water, which would give a capacity of about 46 cubic inches. The minimum capacity which I have assumed above, however, is based upon the valuable tables published by Professor R. Wagner in his *Vorstudien zu einer wissenschaftlichen Morphologie und Physiologie des menschlichen Gehrins.* As the result of the careful weighing of more than 900 human brains, Professor Wagner states that one-half weighed between 1200 and 1400 grammes, and that about two-ninths, consisting for the most part of male brains, exceed 1400 grammes. The lightest brain of an adult male, with sound mental faculties, recorded by Wagner, weighed 1020 grammes. As a gramme equals 15.4 grains, and a cubic inch of water contains 252.4 grains, this is equivalent to 62 cubic inches of water; so that as brain is heavier than water, we are perfectly safe against erring on the side of diminution in taking this as the smallest capacity of any adult male human brain. The only adult male brain, weighing as little as 970 grammes, is that of an idiot; but the brain of an adult woman, against the soundness of whose faculties nothing appears, weighed as little as 907 grammes (55.3 cubic inches of water); and Reid gives an adult female brain of still smaller capacity. The heaviest brain (1872 grammes, or about 115 cubic inches) was, however, that of a woman; next to it comes the brain of Cuvier (1861 grammes), then Byron (1807 grammes), and then an insane person (1783 grammes). The lightest adult brain recorded (720 grammes) was that of an idiotic female. The brains of five children, four years old, weighed between 1275 and 992 grammes. So that it may be safely said, that an average European child of four years old has a brain twice as large as that of an adult Gorilla.

[6] In speaking of the foot of his "Pygmie," Tyson remarks, p. 13:–

"But this part in the formation and in its function too, being liker a Hand than a Foot: for the distinguishing this sort of animals from others, I have thought whether it might not be reckoned and called rather Quadrumanus than Quadrupes, *i.e.*, a four-handed rather than a four-footed animal."

As this passage was published in 1699, M. I. G. St. Hilaire is clearly in error in ascribing the invention of the term "quadrumous" to Buffon, though "bimanous" may belong to him. Tyson uses "Quadrumanus" in several

places, as at p. 91.... "Our *Pygmie* is no Man, nor yet the *common Ape*, but a sort of *Animal* between both; and though a *Biped*, yet of the *Quadrumanus*- kind: though some *Men* too have been observed to use their *Feet* like *Hands* as I have seen several."

[7] I say *help* to furnish: for I by no means believe that it was any original difference of cerebral quality, or quantity which caused that divergence between the human and the pithecoid stirpes, which has ended in the present enormous gulf between them. It is no doubt perfectly true, in a certain sense, that all difference of function is a result of difference of structure, or, in other words, of difference in the combination of the primary molecular forces of living substance; and, starting from this undeniable axiom, objectors occasionally, and with much seeming plausibility, argue that the vast intellectual chasm between the Ape and Man implies a corresponding structural chasm in the organs of the intellectual functions; so that, it is said, the non-discovery of such vast differences proves, not that they are absent, but that Science is incompetent to detect them. A very little consideration, however, will, I think, show the fallacy of this reasoning. Its validity hangs upon the assumption, that intellectual power depends altogether on the brain–whereas the brain is only one condition out of many on which intellectual manifestations depend; the others being, chiefly, the organs of the senses and the motor apparatuses, especially those which are concerned in prehension and in the production of articulate speech.

A man born dumb, notwithstanding his great cerebral mass and his inheritance of strong intellectual instincts, would be capable of few higher intellectual manifestations than an Orang or a Chimpanzee, if he were confined to the society of dumb associates. And yet there might not be the slightest discernible difference between his brain and that of a highly intelligent and cultivated person. The dumbness might be the result of a defective structure of the mouth, or of the tongue, or a mere defective innervation of these parts; or it might result from congenital deafness, caused by some minute defect of the internal ear, which only a careful anatomist could discover.

The argument, that because there is an immense difference between a Man's intelligence and an Ape's, therefore, there must be an equally immense difference between their brains, appears to me to be about as well based as the reasoning by which one should endeavour to prove that, because there is a "great gulf" between a watch that keeps accurate time and another that will not go at all, there is therefore a great structural hiatus between the two watches. A hair in the balance-wheel, a little rust on a pinion, a bend in a tooth of the escapement, a something so slight that only the practised eye of the watchmaker can discover it, may be the source of all the difference.

And believing, as I do, with Cuvier, that the possession of articulate speech is the grand distinctive character of man (whether it be absolutely peculiar to him or not), I find it very easy to comprehend, that some equally inconspicuous structural difference may have been the primary cause of the immeasurable and practically infinite divergence of the Human from the Simian Stirps.

[8] It is so rare a pleasure for me to find Professor Owen's opinions in entire accordance with my own, that I cannot forbear from quoting a paragraph which appeared in his Essay "On the Characters, &c., of the Class Mammalia," in the *Journal of the Proceedings of the Linnean Society of London* for 1857, but is unaccountably omitted in the "Reade Lecture" delivered before the University of Cambridge two years later, which is otherwise nearly a reprint of the paper in question. Prof. Owen writes:

"Not being able to appreciate or conceive of the distinction between the psychical phenomena of a Chimpanzee, and of a Boschisman or of an Aztec, with arrested brain growth, as being of a nature so essential as to preclude a

comparison between them, or as being other than a difference of degree, I cannot shut my eyes to the significance of that all-pervading similitude of structure–every tooth, every bone, strictly homologous–which makes the determination of the difference between *Homo* and *Pithecus* the anatomist's difficulty."

Surely it is a little singular, that the "anatomist," who finds it "difficult" to determine "the difference" between *Homo* and *Pithecus,* should yet range them on anatomical grounds, in distinct sub-classes.

THE HUXLEY FILE

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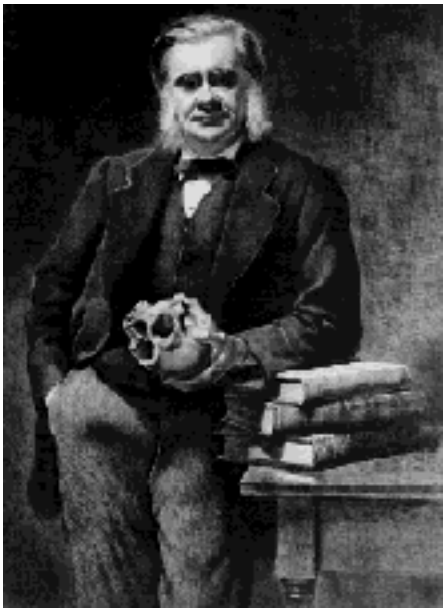

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III

On Some Fossil Remains of Man (1863)

Collected Essays VII

I have endeavoured to show, in the preceding Essay, that the Anthropini, or Man Family, form a very well-defined group of the Primates, between which and the immediately following Family, the Catarhini, there is, in the existing world, the same entire absence of any transitional form or connecting link, as between the Catarhini and Platyrhini.

It is a commonly received doctrine, however, that the structural intervals between the various existing modifications of organic beings may be diminished, or even obliterated, if we take into account the long and varied succession of animals and plants which have preceded these now living and which are known to us only by their fosilized remains. How far this doctrine is well based, how far, on the other hand, as our knowledge at present stands, it is an overstatement of the real facts of the case, and an exaggeration of the con[158]clusions fairly deducible from them, are points of grave importance, but into the discussion of which I do not, at present, propose to enter. It is enough that such a view of the relations of extinct to living beings has been propounded, to lead us to inquire, with anxiety, how far the recent discoveries of human remains in a fossil state bear out, or oppose, that view.

I shall confine myself, in discussing this question, to those fragmentary Human skulls from the caves of Engis in the valley of the Meuse, in Belgium, and of the Neanderthal, near Düsseldorf, the geological relations of which have been examined with so much care by Sir Charles Lyell; upon whose high authority I shall take it for granted, that the Engis skull belonged to a contemporary of the Mammoth (*Elephas primigenius*) and of the woolly Rhinoceros (*Rhinoceros tichorhinus*), with the bones of which it was found associated; and that the Neanderthal skull is of great, though uncertain, antiquity. Whatever be the geological age of the latter skull, I conceive it is quite safe (on the ordinary principles of paleontological reasoning) to assume that the former takes us to, at least, the further side of the vague biological limit, which separates the present geological epoch from that which immediately preceded it. And there can be no doubt that the physical geography of Europe has changed wonderfully, since the bones of Men and Mam[159]moths, Hyænas and Rhinoceroses were washed pell-mell into the cave of Engis.

Fig. 23–The skull from the cave of Engis–viewed from the right side. One half the size of nature. *a* glabella, *b* occipital protuberance (*a* to *b* glabello-occipital line), *c* auditory foramen.

The skull from the cave of Engis was originally discovered by Professor Schmerling, and was described by him, together with other human remains disinterred at the same time, in his [160] valuable work, "Recherches sur les Ossemens fossiles découverts dans les Cavernes de la Province de Liège," published in 1833 (p. 59, *et seq.*), from which the following paragraphs are extracted, the precise expressions of the author being, as far as possible, preserved.

"In the first place, I must remark that these human remains, which are in my possession, are characterised, like the thousands of bones which I have lately been disinterring, by the extent of the decomposition which they have undergone, which is precisely the same as that of the extinct species: all, with a few exceptions, are broken; some few are rounded, as is frequently found to be the case in fossil remains of other species. The fractures are vertical or oblique; none of them are eroded; their colour does not differ from that of other fossil bones, and varies from whitish yellow to blackish. All are lighter than recent bones, with the exception of those which have a calcareous incrustation, and the cavities of which are filled with such matter.

"The cranium which I have caused to be figured, Plate I, figs. 1, 2, is that of an old person. The sutures are beginning to be effaced: all the facial bones are wanting, and of the temporal bones only a fragment of that of the right side is preserved.

"The face and the base of the cranium had been detached before the skull was deposited in the cave, for we were unable to find those parts, though the whole cavern was regularly searched. The cranium was met with at a depth of a metre and a half [five feet nearly] hidden under an osseous breccia, composed of the remains of small animals, and containing one rhinoceros' tusk, with several teeth of horses and of ruminants. This breccia, which has been spoken of above (p. 31), was a metre [3-1/4 feet about] wide, and rose to the height of a metre and a half above the floor of the cavern, to the walls of which it adhered strongly.

[161] "The earth which contained this human skull exhibited no trace of disturbance: teeth of rhinoceros, horse, hyæna, and bear, surrounded it on all sides.

"The famous Blumenbach[1] has directed attention to the differences presented by the form and the dimensions of human crania of different races. This important work would have assisted us greatly, if the face, a part essential for the determination of race, with more or less accuracy, had not been wanting in our fossil cranium.

"We are convinced that even if the skull had been complete, it would not have been possible to pronounce, with certainty, upon a single specimen; for individual variations are so numerous in the crania of one and the same race, that one cannot, without laying one's self open to large chances of error, draw any inference from a single fragment of a cranium to the general form of the head to which it belonged.

"Nevertheless, in order to neglect no point respecting the form of this fossil skull, we may observe that, from the first, the elongated and narrow form of the forehead attracted our attention.

"In fact, the slight elevation of the frontal, its narrowness, and the form of the orbit, approximate it more nearly to the cranium of an Ethiopian than to that of an European; the elongated form and the produced occiput are also characters which we believe to be observable in our fossil cranium; but to remove all doubt upon that subject I have caused the contours of the cranium of an European and of an Ethiopian to be drawn and the foreheads represented. Plate II, Figs. 1 and 2, and, in the same plate Figs. 3 and 4, will render the differences easily distinguishable; and a single glance at the figures will be more instructive than a long and wearisome description.

"At whatever conclusion we may arrive as to the origin of the man from whence this fossil skull proceeded, we may express an opinion without exposing ourselves to a fruitless controversy. Each may adopt the hypothesis which seems to him most probable: for my own part, I hold it to be demonstrated that this [162] cranium has belonged to a person of limited intellectual faculties, and we conclude thence that it belonged to a man of a low degree of civilization: a deduction which is borne out by contrasting the capacity of the frontal with that of the occipital region.

"Another cranium of a young individual was discovered in the floor of the cavern beside the tooth of an elephant; the skull was entire when found, but the moment it was lifted it fell into pieces, which I have not, as yet, been able to put together again. But I have represented the bones of the upper jaw, Plate I, Fig. 5. The state of the alveoli and the teeth, shows that the molars had not yet pierced the gum. Detached milk molars and some fragments of a human skull, proceed from this same place. The figure 3 represents a human superior incisor tooth, the size of which is truly remarkable.[2]

"Figure 4 is a fragment of a superior maxillary bone, the molar teeth of which are worn down to the roots.

"I possess two vertebræ, a first and last dorsal.

"A clavicle of the left side (see Plate III, Fig. 1); although it belonged to a young individual, this bone shows that he must have been of great stature.[3]

"Two fragments of the radius, badly preserved, do not indicate that the height of the man, to whom they belonged, exceeded five feet and a half.

"As to the remains of the upper extremities, those which are in my possession consist merely of a fragment of an ulna and of a radius (Plate III, Figs. 5 and 6).

"Figure 2, Plate IV., represents a metacarpal bone, contained in the breccia, of which we have spoken; it was found in the lower part above the cranium: add to this some metacarpal bones, found at very different distances,

half-a-dozen metatarsals, three phalanges of the hand, and one of the foot.

[163] "This is a brief enumeration of the remains of human bones collected in the cavern of Engis, which has preserved for us the remains of three individuals, surrounded by those of the Elephant, of the Rhinoceros, and of Carnivora of species unknown in the present creation."

From the cave of Engihoul, opposite that of Engis, on the right bank of the Meuse, Schmerling obtained the remains of three other individuals of Man, among which were only two fragments of parietal bones, but many bones of the extremities. In one case, a broken fragment of an ulna was soldered to a like fragment of a radius by stalagmite, a condition frequently observed among the bones of the Cave Bear (*Ursus spelæus*) found in the Belgian caverns.

It was in the cavern of Engis that Professor Schmerling found, incrusted with stalagmite and joined to a stone, the pointed bone implement, which he has figured in Fig. 7 of his Plate XXXVI, and worked flints were found by him in all those Belgian caves, which contained an abundance of fossil bones.

A short letter from M. Geoffroy St. Hilaire, published in the "Comptes Rendus" of the Academy of Sciences of Paris, for July 2nd, 1838, speaks of a visit (and apparently a very hasty one) paid to the collection of Professor "Schermidt" (which is presumably a misprint for Schmerling) at Liège. The writer briefly criticises the drawings which illustrate Schmerling's work, and affirms that the "human [164] cranium is a little longer than it is represented" in Schmerling's figure. The only other remark worth quoting is this:–

"The aspect of the human bones differs little from that of the cave bones, with which we are familiar, and of which there is a considerable collection in the same place. With respect to their special forms, compared with those of the varieties of recent human crania, few *certain* conclusions can be put forward; for much greater differences exist between the different specimens of well-characterized varieties, than between the fossil cranium of Liège and that of one of those varieties selected as a term of comparison."

Geoffroy St. Hilaire's remarks are, it will be observed, little but an echo of the philosophic doubts of the describer and discoverer of the remains. As to the critique upon Schmerling's figures, I find that the side view given by the latter is really about 3/10ths of an inch shorter than the original, and that the front view is diminished to about the same extent. Otherwise the representation is not, in any way, inaccurate, but corresponds very well with the cast which is in my possession.

A piece of the occipital bone, which Schmerling seems to have missed, has since been fitted on to the rest of the cranium by an accomplished anatomist, Dr. Spring of Liege, under whose direction an excellent plaster cast was made for Sir Charles Lyell. It is upon and from a duplicate of that cast that my own observations and the accompanying [165] figures, the outlines of which are copied from very accurate Camera lucida drawings, by my friend Mr. Busk, reduced to one-half of the natural size, are made.

As Professor Schmerling observes, the base of the skull is destroyed, and the facial bones are entirely

absent; but the roof of the cranium, consisting of the frontal, parietal, and the greater part of the occipital bones, as far as the middle of the occipital foramen, is entire, or nearly so. The left temporal bone is wanting. Of the right temporal, the parts in the immediate neighbourhood of the auditory foramen, the mastoid process, and a considerable portion of the squamous element of the temporal are well preserved (Fig. 23).

The lines of fracture which remain between the coadjusted pieces of the skull, and are faithfully displayed in Schmerling's figure, are readily traceable in the cast. The sutures are also discernible, but the complex disposition of their serrations, shown in the figure, is not obvious in the cast. Though the ridges which give attachment to muscles are not excessively prominent, they are well marked, and taken together with the apparently well developed frontal sinuses, and the condition of the sutures, leave no doubt on my mind that the skull is that of an adult, if not middle-aged man.

The extreme length of the skull is 7.7 inches. Its extreme breadth, which corresponds very nearly

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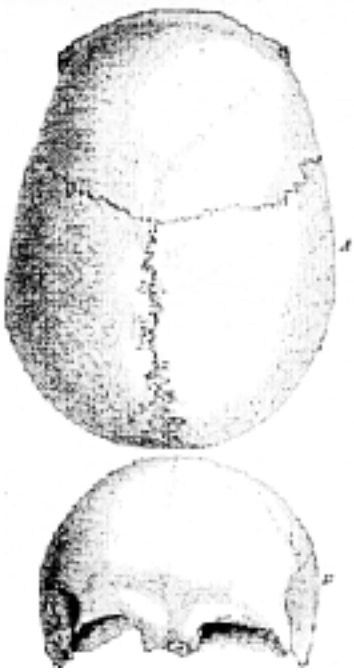

Fig. 24.–The Engis skull viewed from above (*A*) and in front (*B*).

[167] with the interval between the parietal protuberances, is not more than 5.4 inches. The proportion of the length to the breadth is therefore very nearly as l00 to 70. If a line be drawn from the point at which the brow curves in towards the root of the nose, and which is called the "glabella" (*a*), (Fig. 23), to the occipital protuberance (*b*), and the distance to the highest point of the arch of the skull be measured perpendicularly from this line, it will be found to be 4.75 inches. Viewed from above, Fig. 24, *A*, the forehead presents an evenly rounded curve, and passes into the contour of the sides and back of the skull, which describes a tolerably regular elliptical curve.

The front view (Fig. 24, *B*) shows that the roof of the skull was very regularly and elegantly arched in the transverse direction, and that the transverse diameter was a little less below the parietal protuberances, than above them. The forehead cannot be called narrow in relation to the rest of the skull, nor can it be called a retreating forehead; on the contrary, the antero-posterior contour of the skull is well arched, so that the distance along that contour, from the nasal depression to the occipital protuberance, measures about 13.75 inches. The transverse arc of the skull, measured from one auditory foramen to the other, across the middle of the sagittal suture, is about 13 inches. The sagittal suture itself is 5.5 inches long.

The supraciliary prominences or brow-ridges [168] (on each side of *a*, Fig. 23) are well, but not excessively, developed, and are separated by a median depression. Their principal elevation is disposed so obliquely that I judge them to be due to large frontal sinuses.

If a line joining the glabella and the occipital protuberance (*a, b*, Fig. 23) be made horizontal, no part of the occipital region projects more than 1/10th of an inch behind the posterior extremity of that line, and the upper edge of the auditory foramen (*c*) is almost in contact with a line drawn parallel with this upon the outer surface of the skull.

A transverse line drawn from one auditory foramen to the other traverses, as usual, the fore part of the occipital foramen. The capacity of the interior of this fragmentary skull has not been ascertained.

The history of the Human remains from the cavern in the Neanderthal may best be given in the words of their original describer, Dr. Schaaffhausen,[4] as translated by Mr. Busk.

"In the early part of the year 1857, a human skeleton was discovered in a limestone cave in the Neanderthal, near Hochdal, between Düsseldorf and Elberfeld. Of this, however, I was unable to procure more than a plaster cast of the cranium, taken at Elberfeld, from which I drew up an account of its [169] remarkable conformation, which was, in the first instance, read on the 4th of February, 1857, at the meeting of the Lower Rhine Medical and Natural History Society, at Bonn.[5] Subsequently Dr. Fuhlrott, to whom science is indebted for the preservation of these bones, which were not at first regarded as human, and into whose possession they afterwards came, brought the cranium from Elberfeld to Bonn, and entrusted it to me for more accurate anatomical examination. At the General Meeting of the Natural History Society of Prussian Rhineland and Westphalia, at Bonn, on the 2nd of June, 1857,[6] Dr. Fuhlrott himself gave a full account of the locality, and of the circumstances under which the discovery was made. He was of opinion that the bones might be regarded as fossil; and in coming to this conclusion, he laid especial stress upon the existence of dendritic deposits, with which their surface was covered, and which were first noticed upon them by Professor Mayer. To this communication I appended a brief report on the results of my anatomical examination of the bones. The conclusions at which I arrived were: 1st. That the extraordinary form of the skull was due to a natural conformation hitherto not known to exist, even in the most barbarous races. 2nd. That these remarkable human remains belonged to a period antecedent to the time of the Celts and Germans, and were in all probability derived from one of the wild races of North-western Europe, spoken of by Latin writers; and which were encountered as autochthones by the German immigrants. And 3rdly. That it was beyond doubt that these human relics were traceable to a period at which the latest animals of the diluvium still existed; but that no proof of this assumption, nor consequently of their so-termed *fossil* condition,

was afforded by the circumstances under which the bones were discovered.

"As Dr. Fuhlrott has not yet published his description of these circumstances, I borrow the following account of them from one of his letters. 'A small cave or grotto, high enough [170] to admit a man, and about 15 feet deep from the entrance, which is 7 or 8 feet wide, exists in the southern wall of the gorge of the Neanderthal, as it is termed, at a distance of about 100 feet from the Düssel, and about 60 feet above the bottom of the valley. In its earlier and uninjured condition, this cavern opened upon a narrow plateau lying in front of it, and from which the rocky wall descended almost perpendicularly into the river. It could be reached, though with difficulty, from above. The uneven floor was covered to a thickness of 4 or 5 feet with a deposit of mud, sparingly intermixed with rounded fragments of chert. In the removing of this deposit, the bones were discovered. The skull was first noticed, placed nearest to the entrance of the cavern; and further in, the other bones, lying in the same horizontal plane. Of this I was assured, in the most positive terms, by two labourers who were employed to clear out the grotto, and who were questioned by me on the spot. At first no idea was entertained of the bones being human; and it was not till several weeks after their discovery that they were recognised as such by me, and placed in security.

"'But, as the importance of the discovery was not at the time perceived, the labourers were very careless in the collecting, and secured chiefly only the larger bones; and to this circumstance it may be attributed that fragments merely of the probably perfect skeleton came into my possession.'

"My anatomical examination of these bones afforded the following results:–

"The cranium is of unusual size, and of a long-elliptical form. A most remarkable peculiarity is at once obvious in the extraordinary development of the frontal sinuses, owing to which the superciliary ridges, which coalesce completely in the middle, are rendered so prominent, that the frontal bone exhibits a considerable hollow or depression above, or rather behind them, whilst a deep depression is also formed in the situation of the root of the nose. The forehead is narrow and low, though the middle and hinder portions of the cranial arch are well developed. Unfortunately, the fragment of the skull that has been preserved consists only of the portion situated above the roof of the orbits and the superior occipital ridges, which are greatly de[171]veloped, and almost conjoined so as to form a horizontal eminence. It includes almost the whole of the frontal bone, both parietals, a small part of the squamous, and the upper-third of the occipital. The recently featured surfaces show that the skull was broken at the time of its disinterment. The cavity holds 16,876 grains of water, whence its cubical contents may be estimated at 57.64 inches, or 1033.24 cubic centimetres. In making this estimation, the water is supposed to stand on a level with the orbital plane of the frontal, with the deepest notch in the squamous margin of the parietal, and with the superior semicircular ridges of the occipital. Estimated in dried millet-seed, the contents equalled 31 ounces, Prussian Apothecaries' weight. The semicircular line indicating the upper boundary of the attachment of the temporal muscle, though not very strongly marked, ascends nevertheless to more than half the height of the parietal bone. On the right superciliary ridge is observable an oblique furrow or depression, indicative of an injury received during life.[7] The coronal and sagittal sutures are on the exterior nearly closed, and on the inside so completely ossified as to have left no traces whatever, whilst the lambdoidal remains quite open. The depressions for the Pacchionian glands are deep and numerous; and there is an unusually deep vascular groove immediately behind the coronal suture, which, as it terminates in a foramen, no doubt transmitted a *vena emissaria.* The course of the frontal suture is indicated externally by a slight ridge; and where it joins the coronal, this ridge rises into a small protuberance. The course of the sagittal suture is grooved, and above the angle of the occipital bone the parietals are depressed.

	mm.[8]	inches.
The length of the skull from the nasal process of the frontal over the vertex to the superior semicircular lines of the occipital measures . . .	303 (300) =	l2.0."
Circumference over the orbital ridges andthe superior semicircular lines of the occipital . . .	590 (590) =	23.37" or 23".
Width of the frontal from the middle of the temporal line on one side to the same point on the opposite . . .	104 (114) =	4.1" – 4.5".
Length of the frontal from the nasal process to the coronal suture . . .	133 (125) =	5.25" – 5".
Extreme width of the frontal sinuses . . .	25 (23) =	1.0" – 0.9".
Vertical height above a line joining the deepest notches in the squamous border of the parietals . . .	70 =	2.75".
Width of hinder part of skull from one parietal protuberance to the other . . .	138 (150) =	5.4" – 5.9".
Distance from the upper angle of the occipital to the superior semicircular lines . . .	51 (60) =	1.9" – 2.4".
Thickness of the bone at the parietal protuberance . . .	8.	
—at the angle of the occipital . . .	9.	
—at the superior semicircular line of the occipital . . .	10 =	0.3."

"Besides the cranium, the following bones have been secured:–

"1. Both thigh-bones, perfect. These, like the skull, and all the other bones, are characterized by their unusual thickness, and the great development of all the elevations and depressions for the attachment of muscles. In the Anatomical Museum at Bonn, under the designation of 'Giant's-bones,' are some recent thigh bones, with which in thickness the foregoing pretty nearly correspond, although they are shorter.

	Giant's bones.	Fossil bones.
	mm. inches.	mm. inches.
Length . .	542 = 21.4"	438 = 17.4".
Diameter of head of femur . .	54 = 2.14"	53 = 2.0".
[173] Diameter of lower articular end, from one condyle to the other . .	89 = 3.5"	87 = 3.4".
Diameter of femur in the middle . .	33 = 1.2"	30 = 1.1".

"2. A perfect right humerus, whose size shows that it belongs to the thigh-bones.

	mm.	inches.
Length . . .	312 =	12.3".
Thickness in the middle . . .	26 =	1.0".
Diameter of head . . .	49 =	1.9".

"Also a perfect right radius of corresponding dimensions and the upper-third of a right ulna corresponding to the humerus and radius.

"3. A left humerus, of which the upper-third is wanting, and which is so much slenderer than the right as apparently to belong to a distinct individual; a left ulna, which, though complete, is pathologically deformed, the coronoid process being so much enlarged by bony growth, that flexure of the elbow beyond a right angle must have been impossible; the anterior fossa of the humerus for the reception of the coronoid process being also filled up with a similar bony growth. At the same time, the olecranon is curved strongly downwards. As the bone presents no sign of rachitic degeneration, it may be supposed that an injury sustained during life was the cause of the anchylosis. When the left ulna is compared with the right radius, it might at first sight be concluded that the bones respectively belonged to different individuals, the ulna being more than half an inch too short for articulation with a corresponding radius. But it is clear that this shortening, as well as the attenuation of the left humerus, are both consequent upon the pathological condition above described.

"4. A left *ilium,* almost perfect, and belonging to the femur; a fragment of the right *scapula;* the anterior extremity of a rib of the right side; and the same part of a rib of the left side; the hinder part of a rib of the right side; and, lastly, two [174] hinder portions and one middle portion of ribs which, from their unusually rounded shape, and abrupt curvature, more resemble the ribs of a carnivorous animal than those of a man. Dr. H. v. Meyer, however, to whose judgment I defer, will not venture to declare them to be ribs of any animal; and it only remains to suppose that this abnormal condition has arisen from an unusually powerful development of the thoracic muscles.

"The bones adhere strongly to the tongue, although, as proved by the use of hydrochloric acid, the greater part of the cartilage is still retained in them, which appears, however, to have undergone that transformation into gelatine which has been observed by v. Bibra in fossil bones. The surface of all the bones is in many spots covered with minute black specks, which, more especially under a lens, are seen to be formed of very delicate *dendrites.* These deposits, which were first observed on the bones by Dr. Mayer, are most distinct on the inner surface of the cranial bones. They consist of a ferruginous compound, and, from their black colour, may be supposed to contain manganese. Similar dendritic formations also occur, not unfrequently, on laminated rocks, and are usually found in minute fissures and cracks. At the meeting of the Lower Rhine Society at Bonn, on the 1st April, 1857, Prof. Mayer stated that he had noticed in the museum of Poppelsdorf similar dendritic crystallizations on several fossil bones of animals, and particularly on those of *Ursus spelæus*, but still more abundantly and beautifully displayed on the fossil bones and teeth of *Equus adamiticus, Elephas primigenius,* &c., from the caves of Bolve and Sundwig. Faint indications of similar *dendrites* were visible in a Roman skull from Siegburg; whilst other ancient skulls, which had lain for centuries in the earth, presented no trace of them.[9] I am indebted to H. v. Meyer for the following remarks on this subject:–

""The incipient formation of dendritic deposits, which were formerly regarded as a sign of a truly fossil condition,

is interesting. It has even been supposed that in diluvial deposits [175] the presence of *dendrites* might be regarded as affording a certain mark of distinction between bones mixed with the diluvium at a somewhat later period and the true diluvial relics, to which alone it was supposed that these deposits were confined. But I have long been convinced that neither can the absence of *dendrites* be regarded as indicative of recent age, nor their presence as sufficient to establish the great antiquity of the objects upon which they occur. I have myself noticed upon paper, which could scarcely be more than a year old, dendritic deposits, which could not be distinguished from those on fossil bones. Thus I possess a dog's skull from the Roman colony of the neighbouring Heddersheim, *Castrum Hadrianum,* which is in no way distinguishable from the fossil bones from the Frankish caves; it presents the same colour, and adheres to the tongue just as they do; so that this character also, which, at a former meeting of German naturalists at Bonn, gave rise to amusing scenes between Buckland and Schmerling, is no longer of any value. In disputed cases, therefore, the condition of the bone can scarcely afford the means for determining with certainty whether it be fossil, that is to say, whether it belong to geological antiquity or to the historical period."

"As we cannot now look upon the primitive world as representing a wholly different condition of things, from which no transition exists to the organic life of the present time, the designation of *fossil,* as applied to *a bone,* has no longer the sense it conveyed in the time of Cuvier. Sufficient grounds exist for the assumption that man coexisted with the animals found in the *diluvium;* and many a barbarous race may, before all historical time, have disappeared, together with the animals of the ancient world, whilst the races whose organization is improved have continued the genus. The bones which form the subject of this paper present characters which, although not decisive as regards a geological epoch, are, nevertheless, such as indicate a very high antiquity. It may also be remarked that, common as is the occurrence of diluvial animal bones in the muddy deposits of caverns, such remains have not hitherto [176] been met with in the caves of the Neanderthal; and that the bones, which were covered by a deposit of mud not more than four or five feet thick, and without any protective covering of stalagmite, have retained the greatest part of their organic substance.

"These circumstances might be adduced against the probability of a geological antiquity. Nor should we be justified in regarding the cranial conformation as perhaps representing the most savage primitive type of the human race, since crania exist among living savages, which, though not exhibiting such a remarkable conformation of the forehead, which gives the skull somewhat the aspect of that of the large apes, still in other respects, as for instance in the greater depth of the temporal fossæ, the crest-like, prominent temporal ridges, and a generally less capacious cranial cavity, exhibit an equally low stage of development. There is no reason for supposing that the deep frontal hollow is due to any artificial flattening, such as is practised in various modes by barbarous nations in the Old and New World. The skull is quite symmetrical, and shows no indication of counter-pressure at the occiput, whilst, according to Morton, in the Flat-heads of the Columbia, the frontal and parietal bones are always unsymmetrical. Its conformation exhibits the sparing development of the anterior part of the head which has been so often observed in very ancient crania, and affords one of the most striking proofs of the influence of culture and civilization on the form of the human skull."

In a subsequent passage, Dr. Schaaffhausen remarks:

"There is no reason whatever for regarding the unusual development of the frontal sinuses in the remarkable skull from the Neanderthal as an individual or pathological deformity; it is unquestionably a typical race-character, and is physiologically connected with the uncommon thickness of the other bones of the skeleton, which exceeds by about one-half the usual proportions. This expansion of the frontal sinuses, which are [177] appendages of the air-passage, also indicates an unusual force and power of endurance in the movements of the body, as may be

concluded from the size of all the ridges and processes for the attachment of the muscles or bones. That this conclusion may be drawn from the existence of large frontal sinuses, and a prominence of the lower frontal region, is confirmed in many ways by other observations. By the same characters, according to Pallas, the wild horse is distinguished from the domesticated, and, according to Cuvier, the fossil cave-bear from every recent species of bear, whilst, according to Roulin, the pig, which has become wild in America, and regained a resemblance to the wild boar, is thus distinguished from the same animal in the domesticated state, as is the chamois from the goat; and, lastly, the bull-dog, which is characterised by its large bones and strongly developed muscles from every other kind of dog. The estimation of the facial angle, the determination of which, according to Professor Owen, is also difficult in the great apes, owing to the very prominent supra-orbital ridges, in the present case is rendered still more difficult from the absence both of the auditory opening and of the nasal spine. But if the proper horizontal position of the skull be taken from the remaining portions of the orbital plates, and the ascending line made to touch the surface of the frontal bone behind the prominent supra-orbital ridges, the facial angle is not found to exceed 56°.[10] Unfortunately, no portions of the facial bones, whose conformation is so decisive as regards the form and expression of the head, have been preserved. The cranial capacity, compared with the uncommon strength of the corporeal frame, would seem to indicate a small cerebral development. The skull, as it is, holds about 31 ounces of millet-seed; and as, from the proportionate size of the wanting bones, the whole cranial cavity should have about 6 ounces more added, the contents, were it perfect, may be taken at 37 ounces. Tiedemann assigns, as the cranial contents in the Negro, 40, 38, and 35 ounces. The cranium holds rather more than 36 ounces of water which [178] corresponds to a capacity of 1033.24 cubic centimetres. Huschke estimates the cranial contents of a Negress at 1127 cubic centimeters; of an old Negro at 1146 cubic centimetres. The capacity of the Malay skulls, estimated by water, equalled 36, 33 ounces, whilst in the diminutive Hindoos it falls to as little as 27 ounces."

After comparing the Neanderthal cranium with many others, ancient and modern, Professor Schaaffhausen concludes thus:–

"But the human bones and cranium from the Neanderthal exceed all the rest in those peculiarities of conformation which lead to the conclusion of their belonging to a barbarous and savage race. Whether the cavern in which they were found, unaccompanied with any trace of human art, were the place of their internment, or whether, like the bones of extinct animals elsewhere, they had been washed into it, they may still be regarded as the most ancient memorial of the early inhabitants of Europe."

Mr. Busk, the translator of Dr. Schaaffhausen's paper, has enabled us to form a very vivid conception of the degraded character of the Neanderthal skull, by placing side by side with its outline, that of the skull of a Chimpanzee, drawn to the same absolute size.

Some time after the publication of the translation of Professor Schaaffhausen's Memoir, I was led to study the cast of the Neanderthal cranium with more attention than I had previously bestowed upon it, in consequence of wishing to supply Sir Charles Lyell with a diagram, exhibiting the special peculiarities of this skull, as compared [179] with other human skulls. In order to do this it was necessary to identify, with precision, those points in the skulls compared which corresponded anatomically. Of these points, the glabella was obvious enough; but when I had distinguished another, defined by the occipital protuberance and superior semi-circular line, and had placed the outline of the Neanderthal skull against that of the Engis skull, in such a position that the glabella and occipital protuberance of both were

intersected by the same straight line, the difference was so vast and the flattening of the Neanderthal skull so prodigious (compare Figs. 23 and 25 A), that I at first imagined I must have fallen into some error. And I was the more inclined to suspect this, as, in ordinary human skulls, the occipital protuberance and superior semicircular curved line on the exterior of the occiput correspond pretty closely with the "lateral sinuses" and the line of attachment of the tentorium internally. But on the tentorium rests, as I have said in the preceding Essay, the posterior lobe of the brain; and hence, the occipital protuberance, and the curved line in question, indicate, approximately, the lower limits of that lobe. Was it possible for a human being to have the brain thus flattened and depressed; or, on the other hand, had the muscular ridges shifted their position? In order to solve these doubts, and to decide the question whether the great supraciliary projections did, or

[180-181]

Fig. 25.–The skull from the Neanderthal cavern. A, side, [181] B, front, and C, top view. One half the natural size. The outlines from camera lucida drawings, one half the natural size, by Mr. Busk: he details from the cast and from Dr. Fuhlrott's photographs. *a* glabella; *b* occipital protuberance; *d* lambdoidal suture.

did not, arise from the development of the frontal sinuses, I requested Sir Charles Lyell to be so good as to obtain for me from Dr. Fuhlrott, [181] the possessor of the skull, answers to certain queries, and if possible a cast, or at any rate drawings, or photographs of the interior of the skull.

Dr. Fuhlrott replied, with a courtesy and readiness for which I am infinitely indebted to him, to my inquiries, and furthermore sent three excellent photographs. One of these gives a side [182] view of the skull, and from it Fig. 25 A has been shaded. The second (Fig. 26 A) exhibits the wide openings of the frontal sinuses upon the inferior surface of the frontal part of the skull, into which, Dr. Fuhlrott writes, "a probe may be introduced to the depth of an inch," and demonstrates the great extension of the thickened supraciliary ridges beyond the cerebral cavity. The third, lastly (Fig. 26 B), exhibits the edge and the

interior of the posterior, or occipital, part of the skull, and shows very clearly the two depressions for the lateral sinuses, sweeping inwards towards the middle line of the roof of the skull, to form the longitudinal sinus. It was clear, therefore, that I had not erred in my interpretation, and that the posterior lobe of the brain of the Neanderthal man must have been as much flattened as I suspected it to be.

In truth, the Neanderthal cranium has most extraordinary characters. It has an extreme length of 8 inches, while its breadth is only 5.75 inches, or, in other words, its length is to its breadth as 100:72. It is exceedingly depressed, measuring only about 3.4 inches from the glabello-occipital line to the vertex. The longitudinal arc, measured in the same way as in the Engis skull, is 12 inches; the transverse arc cannot be exactly ascertained, in consequence of the absence of the temporal bones, but was probably about the same, and certainly exceeded l0-1/4 inches. The hori[183]zontal circumference is 23 inches.

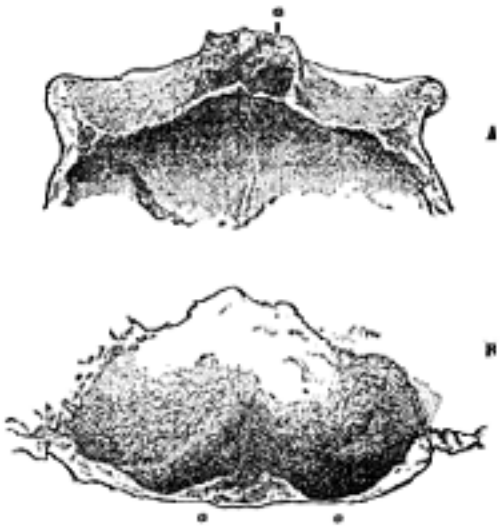

Fig. 26.–Drawings from Dr. Fuhlrott's photographs of parts of the interior of the Neanderthal cranium. A view of the under and inner surface of the frontal region, showing the inferior apertures impressions of the lateral sinuses (*aa*).

But this great circumference arises largely from the vast development of the supraciliary ridges, though the perimeter of the brain case itself is not small. [184] The large supraciliary ridges give the forehead a far more retreating appearance than its internal contour would bear out.

To an anatomical eye, the posterior part of the skull is even more striking than the anterior. The occipital protuberance occupies the extreme posterior end of the skull, when the glabello-occipital line is made horizontal, and so far from any part of the occipital region extending beyond it, this region of the skull slopes obliquely upward and forward, so that the lambdoidal suture is situated well upon the upper surface of the cranium. At the same time, notwithstanding the great length of the skull, the sagittal suture is remarkably short (4-1/2 inches), and the squamosal suture is very straight.

In reply to my questions Dr. Fuhlrott writes that the occipital bone "is in a state of perfect preservation as far as the upper semicircular line, which is a very strong ridge, linear at its extremities, but enlarging towards the middle, where it forms two ridges (bourrelets), united by a linear continuation, which is

slightly depressed in the middle."

"Below the left ridge the bone exhibits an obliquely inclined surface, six lines (French) long, and twelve lines wide."

This last must be the surface, the contour of which is shown in Fig. 25 A, below *b*. It is particularly interesting, as it suggests that, [185] notwithstanding the flattened condition of the occiput, the posterior cerebral lobes must have projected considerably beyond the cerebellum, and as it constitutes one among several points of similarity between the Neanderthal cranium and certain Australian skulls.

Such are the two best known forms of human cranium, which have been found in what may be fairly termed a fossil state. Can either be shown to fill up or diminish, to any appreciable extent, the structural interval which exists between Man and the man-like apes? Or, on the other hand, does neither depart more widely from the average structure of the human cranium, than normally formed skulls of men are known to do at the present day?

It is impossible to form any opinion on these questions, without some preliminary acquaintance with the range of variation exhibited by human structure in general–a subject which has been but imperfectly studied, while even of what is known, my limits will necessarily allow me to give only a very imperfect sketch.

The student of anatomy is perfectly well aware that there is not a single organ of the human body the structure of which does not vary, to a greater or less extent, in different individuals. The skeleton varies in the proportions, and even to a certain extent in the connexions, of its con[186]stituent bones. The muscles which move the bones vary largely in their attachments. The varieties in the mode of distribution of the arteries are carefully classified, on account of the practical importance of a knowledge of their shiftings to the surgeon. The characters of the brain vary immensely, nothing being less constant than the form and size of the cerebral hemispheres, and the richness of the convolutions upon their surface, while the most changeable structures of all in the human brain are exactly those on which the unwise attempt has been made to base the distinctive characters of humanity, viz. the posterior cornu of the lateral ventricle, the hippocampus minor, and the degree of projection of the posterior lobe beyond the cerebellum. Finally, as all the world knows, the hair and skin of human beings may present the most extraordinary diversities in colour and in texture.

So far as our present knowledge goes, the majority of the structural varieties to which allusion is here made, are individual. The ape-like arrangement of certain muscles which is occasionally met with[11] in the white races of mankind, is not known to be more common among Negroes or Australians: nor because the brain of the Hottentot Venus was found to be smoother, to have its convolutions more symmetrically disposed,

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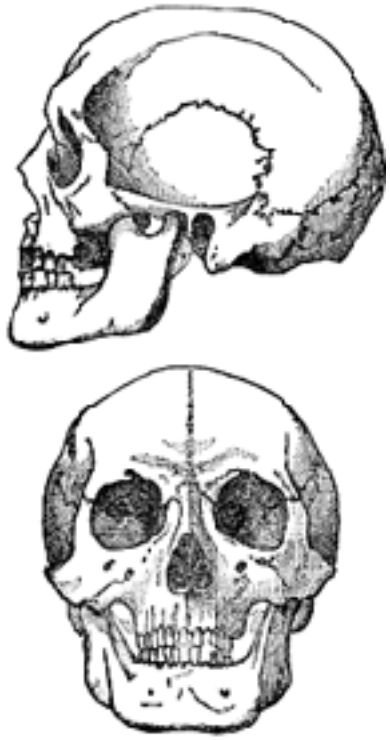

Fig. 27.–Side and front views of the round and orthognathous skull of a Calmuck after Von Baer. One-third the natural size.

[188] and to be, so far, more ape-like than that of ordinary Europeans, are we justified in concluding a like condition of the brain to prevail universally among the lower races of mankind, however probable that conclusion may be.

We are, in fact, sadly wanting in information respecting the disposition of the soft and destructible organs of every Race of Mankind but our own; and even of the skeleton, our Museums are lamentably deficient in every part but the cranium. Skulls enough there are, and since the time when Blumenbach and Camper first called attention to the marked and singular differences which they exhibit, skull collecting and skull measuring has been a zealously pursued branch of Natural History, and the results obtained have been arranged and classified by various writers, among whom the late active and able Retzius must always be the first named.

Human skulls have been found to differ from one another, not merely in their absolute size and in the absolute capacity of the brain case, but in the proportions which the diameters of the latter bear to one another; in the relative size of the bones of the face (and more particularly of the jaws and teeth) as compared with those of the skull; in the degree to which the upper jaw (which is of course followed by the lower) is thrown backwards and downwards under the forepart of the brain case, or forwards and upwards in front of [189] and beyond it. They differ further in the relations of the transverse diameter of the face, taken through the cheek bones, to the transverse diameter of the skull; in the more rounded or more gable-like form of the roof of the skull, and in the degree to which the hinder part of the skull is flattened or projects beyond the ridge, into and below which the muscles of the neck are inserted.

In some skulls the brain case may be said to be "*round*," the extreme length not exceeding the extreme breadth by a greater proportion than 100 to 80, while the difference may be much less.[12] Men possessing such skulls were termed by Retzius "*brachycephalic*," and the skull of a Calmuck, of which a front and side view (reduced outline copies of which are given in Figure 27) are depicted by Von Baer in his excellent "Crania selecta," affords a very admirable sample of that kind of skull. Other skulls, such as that of a Negro copied in Fig. 28 from Mr. Busk's "Crania typica," have a very different, greatly elongated form, and may be termed "*oblong.*" In this skull the extreme length is to the extreme breadth as 100 to not more than 67, and the transverse diameter of the human skull may fall below even this proportion. People having such skulls were called by Retzius "*dolichocephalic.*"

The most cursory glance at the side views of

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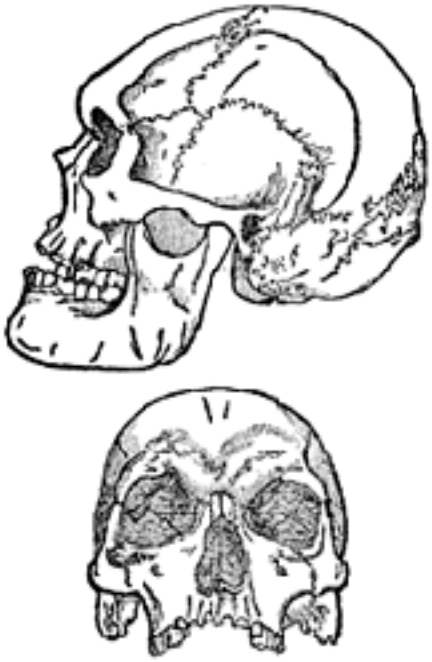

Fig. 28–Oblong and prognathous skull of a Negro; side and front views. One-third of the natural size.

[191] these two skulls will suffice to prove that they differ, in another respect, to a very striking extent. The profile of the face of the Calmuck is almost vertical, the facial bones being thrown downwards and under the fore part of the skull. The profile of the face of the Negro, on the other hand, is singularly inclined, the front part of the jaws projecting far forward beyond the level of the fore part of the skull. In the former case the skull is said to be "*orthognathous*" or straight-jawed; in the latter, it is called "*prognathous,*" a term which has been rendered, with more force than elegance, by the Saxon equivalent,–"snouty."

Various methods have been devised in order to express with some accuracy the degree of prognathism or orthognathism of any given skull; most of these methods being essentially modifications of that devised by Peter Camper, in order to attain what he called the "facial angle."

But a little consideration will show that any "facial angle" that has been devised, can be competent to express the structural modifications involved in prognathism and orthognathism, only in a rough and general sort of way. For the lines, the intersection of which forms the facial angle, are drawn through points of the skull, the position of each of which is modified by a number of circumstances, so that the angle obtained is a complex resultant of all these circumstances, and is not the expression of any one definite organic relation of the parts of the skull.

[192] I have arrived at the conviction that no comparison of crania is worth very much that is not founded upon the establishment of a relatively fixed base line, to which the measurements, in all cases, must be referred. Nor do I think it is a very difficult matter to decide what that base line should be. The parts of the skull, like those of the rest of the animal framework, are developed in succession: the base of the skull is formed before its sides and roof; it is converted into cartilage earlier and more completely than the sides and roof: and the cartilaginous base ossifies, and becomes soldered into one piece long before the roof. I conceive then that the base of the skull may be demonstrated developmentally to be its relatively fixed part, the roof and sides being relatively movable.

The same truth is exemplified by the study of the modifications which the skull undergoes in ascending from the lower animals up to man.

In such a mammal as a Beaver (Fig. 29), a line (*a b*) drawn through the bones, termed basioccipital, basisphenoid, and presphenoid, is very long in proportion to the extreme length of the cavity which contains the cerebral hemispheres (*g h*). The plane of the occipital foramen (*b c*) forms a slightly acute angle with this "basicranial axis," while the plane of the tentorium (*i T*) is inclined at rather more than 90° to the "basicranial axis"; and so is the plane of the perforated plate (*a d*), by which the filaments of the olfactory nerve

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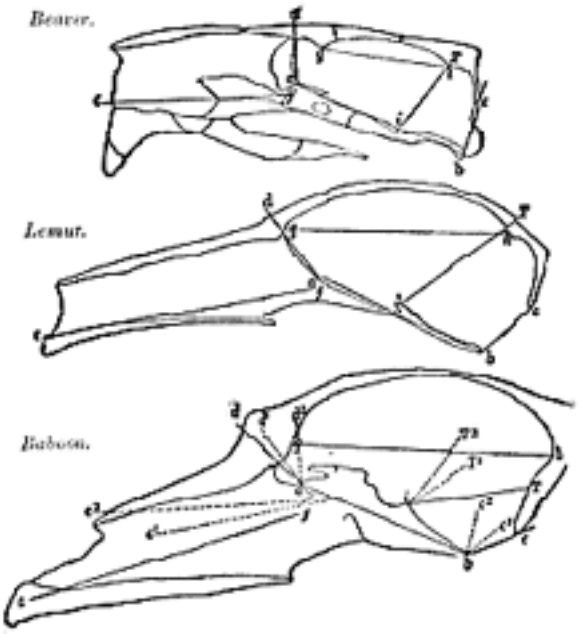

Fig. 29–Longitudinal and vertical sections of the skulls of a Beaver (*Castor Canadensis*), a Lemur (*L. Catta*), and a Baboon (*Cynocephalus Papio*), *a b*, the basicranial axis; *b c*, the occipital plane; *i T*, the tentorial plane; *a d*, the olfactory plane; *f e*, the basifacial axis; *c b a*, occipital angle; *T i a*, tentorial angle; *d a b*, olfactory angle; *e f b*, cranio-facial angle; *g h*, extreme length of the cavity which lodges the cerebral hemispheres or "cerebral length." The length of the basicranial axis as to this length, or, in other words, the proportional length of the line *g h* to that of *a b* taken as 100, in the three skulls is as [194] follows:–Beaver, 70 to 100; Lemur, 119 to 100; Baboon, 144 to 100. In an adult male Gorilla the cerebral length is as 170 to the basicranial axis taken as 100, in the Negro (Fig. 30) as 236 to 100. In the Constantinople skull (Fig. 30) it is as 266 to l00. The difference between the highest Ape's skull and the lowest Man's is therefore very strikingly brought out by these measurements. In the diagram of the Baboon's skull the dotted lines d^1 d^2, &c., give the angles of the Lemur's and Beaver's skull, as laid down upon the basicranial axis of the Baboon. The line *a b* has the same length in each diagram.

leave the skull. Again, a line drawn through the axis of the face between the bones called ethmoid and vomer–the "basifacial axis" (*f e*) forms an exceedingly obtuse angle, where, when produced, it cuts the "basicranial axis."

If the angle made by the line *b c* with *a b*, be called the "occipital angle," and the angle made by the line *a d* with *a b* be termed the "olfactory angle" and that made by *i T* with *a b* the "tentorial angle" then all these, in the mammal in question, are nearly right angles, varying between 80° and 110°. The angle *e f b*, or that made by the cranial with the facial axis, and which may be termed the "cranio-facial angle," is extremely obtuse, amounting, in the case of the Beaver, to at least 150°.

But if a series of sections of mammalian skulls, intermediate between a Rodent and a Man (Fig. 29), be examined, it will be found that in the higher crania the basi-cranial axis becomes shorter relatively to the cerebral length; that the "olfac[195]tory angle" and "occipital angle" become more obtuse; and that the "cranio-facial angle," becomes more acute by the bending down, as it were, of the facial axis upon the cranial axis. At the same time, the roof of the cranium becomes more and more arched, to allow of the

increasing height of the cerebral hemispheres, which is eminently characteristic of man, as well as of that backward extension, beyond the cerebellum, which reaches its maximum in the South American Monkeys. So that, at last, in the human skull (Fig. 30), the cerebral length is between twice and thrice as great as the length of the basicranial axis; the olfactory plane is 20° or 30° on the *under* side of that axis; the occipital angle, instead of being less than 90°, is as much as 150° or 160°; the cranio-facial angle may be 90° or less, and the vertical height of the skull may have a large proportion to its length.

It will be obvious, from an inspection of the diagrams, that the basicranial axis is, in the ascending series of Mammalia, a relatively fixed line, on which the bones of the sides and roof of the cranial cavity, and of the face, may be said to revolve downwards and forwards or backwards, according to their position. The arc described by any one bone or plane, however, is not by any means always in proportion to the arc described by another. Now comes the important question, can we

[196]

Fig. 30.–Sections of orthognathous (light contour) and prognathous (dark contour) skulls, one-third of the natural size. *a b* Basicranial axis; *b c*, *b′ c′*, plane of the occipital foramen; *d d′*, hinder end of the palatine bone; *e e′*, front end of the upper jaw; *T T′*, insertion of the tentorium.

[197] discern, between the lowest and the highest forms of the human cranium anything answering, in however slight a degree, to this revolution of the side and roof bones of the skull upon the basicranial axis observed upon so great a scale in the mammalian series? Numerous observations lead me to believe that we must answer this question in the affirmative.

The diagrams in Figure 30 are reduced from very carefully made diagrams of sections of four skulls, two round and orthognathous, two long and prognathous, taken longitudinally and vertically, through the middle. The sectional diagrams have then been superimposed, in such a manner, that the basal axes of

the skulls coincide by their anterior ends, and in their direction. The deviations of the rest of the contours (which represent the interior of the skulls only) show the differences of the skulls from one another, when these axes are regarded as relatively fixed lines.

The dark contours are those of an Australian and of a Negro skull: the light contours are those of a Tartar skull, in the Museum of the Royal College of Surgeons; and of a well developed round skull from a cemetery in Constantinople, of uncertain race, in my own possession.

It appears, at once, from these views, that the prognathous skulls, so far as their jaws are concerned, do really differ from the orthognathous in [198] much the same way as, though to a far less degree than, the skulls of the lower mammals differ from those of Man. Furthermore, the plane of the occipital foramen (*b c*) forms a somewhat smaller angle with the axis in these particular prognathous skulls than in the orthognathous; and the like may be slightly true of the perforated plate of the ethmoid–though this point is not so clear. But it is singular to remark that, in another respect, the prognathous skulls are less ape-like than the orthognathous, the cerebral cavity projecting decidedly more beyond the anterior end of the axis in the prognathous, than in the orthognathous, skulls.

It will be observed that these diagrams reveal an immense range of variation in the capacity and relative proportion to the cranial axis, of the different regions of the cavity which contains the brain, in the different skulls. Nor is the difference in the extent to which the cerebral overlaps the cerebellar cavity less singular. A round skull (Fig. 30, *Const.*) may have a greater posterior cerebral projection than a long one (Fig. 30, *Negro*).

Until human crania have been largely worked out in a manner similar to that here suggested–until it shall be an opprobrium to an ethnological collection to possess a single skull which is not bisected longitudinally–until the angles and measurements here mentioned, together with a [199] number of others of which I cannot speak in this place, are determined, and tabulated with reference to the basicranial axis as unity, for large numbers of skulls of the different races of Mankind, I do not think we shall have any very safe basis for that ethnological craniology which aspires to give the anatomical characters of the crania of the different Races of Mankind.

At present, I believe that the general outlines of what may be safely said upon that subject may be summed up in a very few words. Draw a line on a globe, from the Gold Coast in Western Africa to the steppes of Tartary. At the southern and western end of that line there live the most dolichocephalic, prognathous, curly-haired, dark-skinned of men–the true Negroes. At the northern and eastern end of the same line there live the most brachycephalic, orthognathous, straight-haired, yellow-skinned of men–the Tartars and Calmucks. The two ends of this imaginary line are indeed, so to speak, ethnological antipodes. A line drawn at right angles, or nearly so, to this polar line through Europe and Southern Asia to Hindostan, would give us a sort of equator, around which round-headed, oval-headed, and oblong-headed, prognathous and orthognathous, fair and dark races–but none possessing the excessively marked characters of Calmuck or Negro–group themselves.

It is worthy of notice that the regions of the [200] antipodal races are antipodal in climate, the greatest contrast the world affords, perhaps, being that between the damp, hot, steaming, alluvial coast plains of the West Coast of Africa and the arid, elevated steppes and plateaux of Central Asia, bitterly cold in winter, and as far from the sea as any part of the world can be.

From Central Asia eastward to the Pacific Islands and subcontinents on the one hand, and to America on the other, brachycephaly and orthognathism gradually diminish, and are replaced by dolichocephaly and prognathism, less, however, on the American Continent (throughout the whole length of which a rounded type of skull prevails largely, but not exclusively)[13] than in the Pacific region, where, at length, on the Australian Continent and in the adjacent islands, the oblong skull, the projecting jaws, and the dark skin reappear; with so much departure, in other respects, from the Negro type, that ethnologists assign to these people the special title of "Negritoes."

The Australian skull is remarkable for its narrowness and for the thickness of its walls, especially in the region of the supraciliary ridge, which is frequently, though not by any means invariably, solid throughout, the frontal sinuses remaining undeveloped. The nasal depression, [201] again, is extremely sudden, so that the brows overhang and give the countenance a particularly lowering, threatening expression. The occipital region of the skull, also, not unfrequently becomes less prominent; so that it not only fails to project beyond a line drawn perpendicular to the hinder extremity of the glabello-occipital line, but even, in some cases, begins to shelve away from it, forwards, almost immediately. In consequence of this circumstance, the parts of the occipital bone which lie above and below the tuberosity make a much more acute angle with one another than is usual, whereby the hinder part of the base of the skull appears obliquely truncated. Many Australian skulls have a considerable height, quite equal to that of the average of any other race, but there are others in which the cranial roof becomes remarkably depressed, the skull, at the same time, elongating so much that, probably, its capacity is not diminished. The majority of skulls possessing these characters, which I have seen, are from the neighbourhood of Port Adelaide in South Australia, and have been used by the natives as water vessels; to which end the face has been knocked away, and a string passed through the vacuity and the occipital foramen, so that the skull was suspended by the greater part of its basis.

Figure 31 represents the contour of a skull of this kind from Western Port, with the jaw attached, and of the Neanderthal skull, both [202] reduced to one-third of the size of nature. A small additional amount of flattening and lengthening, with a corresponding increase of the supraciliary ridge, would convert the Australian brain case into a form identical with that of the aberrant fossil.

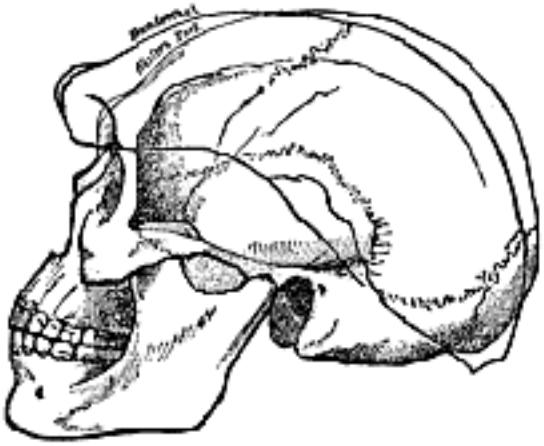

Fig. 31.–An Australian skull from Western Port, in the Museum of the Royal College of Surgeons, with the contour of the Neanderthal skull. Both reduced to one-third the natural size.

And now, to return to the fossil skulls, and to the rank which they occupy among, or beyond, [203] these existing varieties of cranial conformation. In the first place, I must remark, that, as Professor Schmerling well observed (*supra*, p. 161) in commenting upon the Engis skull, the formation of a safe judgment upon the question is greatly hindered by the absence of the jaws from both the crania, so that there is no means of deciding, with certainty, whether they were more or less prognathous than the lower existing races of mankind. And yet, as we have seen, it is more in this respect than any other, that human skulls vary, towards and from, the brutal type–the brain case of an average dolichocephalic European differing far less from that of a Negro, for example, than his jaws do. In the absence of the jaws, then, any judgment on the relations of the fossil skulls to recent Races must be accepted with a certain reservation.

But taking the evidence as it stands, and turning first to the Engis skull, I confess I can find no character in the remains of that cranium which, if it were a recent skull, would give any trustworthy clue as to the Race to which it might appertain. Its contours and measurements agree very well with those of some Australian skulls which I have examined–and especially has it a tendency towards that occipital flattening, to the great extent of which, in some Australian skulls, I have alluded. But all Australian skulls do not present this flattening, and the supraciliary ridge [204] of the Engis skull is quite unlike that of the typical Australians.

On the other hand, its measurements agree equally well with those of some European skulls. And assuredly, there is no mark of degradation about any part of its structure. It is, in fact, a fair average human skull, which might have belonged to a philosopher, or might have contained the thoughtless brains of a savage.

The case of the Neanderthal skull is very different. Under whatever aspect we view this cranium, whether we regard its vertical depression, the enormous thickness of its supraciliary ridges, its sloping occiput, or its long and straight squamosal suture, we meet with ape-like characters, stamping it as the most pithecoid of human crania yet discovered. But Professor Schaaffhausen states (*supra*, p. 178), that the cranium, in its present condition, holds 1033.24 cubic centimetres of water, or about 63 cubic inches,

and as the entire skull could hardly have held less than an additional 12 cubic inches, its capacity may be estimated at about 75 cubic inches, which is the average capacity given by Morton for Polynesian and Hottentot skulls.

So large a mass of brain as this, would alone suggest that the pithecoid tendencies, indicated by this skull, did not extend deep into the organization; and this conclusion is borne out by the dimensions of the other bones of the skeleton [205] given by Professor Schaaffhausen, which show that the absolute height and relative proportions of the limbs, were quite those of an European of middle stature. The bones are indeed stouter, but this and the great development of the muscular ridges noted by Dr. Schaaffhausen, are characters to be expected in savages. The Patagonians, exposed without shelter or protection to a climate possibly not very dissimilar from that of Europe at the time during which the Neanderthal man lived, are remarkable for the stoutness of their limb bones.

In no sense, then, can the Neanderthal bones be regarded as the remains of a human being intermediate between Men and Apes. At most, they demonstrate the existence of a Man whose skull may be said to revert somewhat towards the pithecoid type–just as a Carrier, or a Pouter, or a Tumbler, may sometimes put on the plumage of its primitive stock, the *Columba livia.* And indeed, though truly the most pithecoid of known human skulls, the Neanderthal cranium is by no means so isolated as it appears to be at first, but forms, in reality, the extreme term of a series leading gradually from it to the highest and best developed of human crania. On the one hand, it is closely approached by the flattened Australian skulls, of which I have spoken, from which other Australian forms lead us gradually up to skulls having very much the type of the Engis cranium.

[206]

Fig. 32–Ancient Danish skull from a tumulus at Borreby one-third of the natural size. From a camera lucida drawing by Mr. Busk

[207] And, on the other hand, it is even more closely affined to the skulls of certain ancient people who inhabited Denmark during the "stone period," and were probably either contemporaneous with, or later than, the makers of the "refuse heaps," or "Kjokkemöddings" of that country.

The correspondence between the longitudinal contour of the Neanderthal skull and that of some of those skulls from the tumuli at Borreby, very accurate drawings of which have been made by Mr. Busk, is very close. The occiput is quite as retreating, the supraciliary ridges are nearly as prominent, and the skull is as low. Furthermore, the Borreby skull resembles the Neanderthal form more closely than any of the Australian skulls do, by the much more rapid retrocession of the forehead. On the other hand, the Borreby skulls are all somewhat broader, in proportion to their length, than the Neanderthal skull, while some attain that proportion of breadth to length (80: 100) which constitutes brachycephaly.[14]

In conclusion, I may say, that the fossil remains of Man hitherto discovered do not seem to me to [208] take us appreciably nearer to that lower pithecoid form, by the modification of which he has, probably, become what he is. And considering what is now known of the most ancient Races of men; seeing that they fashioned flint axes and flint knives and bone-skewers, of much the same pattern as those fabricated by the lowest savages at the present day, and that we have every reason to believe the habits and modes of living of such people to have remained the same from the time of the Mammoth and the tichorhine Rhinoceros till now, I do not know that this result is other than might be expected.

Where, then, must we look for primæval Man? Was the oldest *Homo sapiens* pliocene or miocene, or yet more ancient? In still older strata do the fossilized bones of an ape more anthropoid, or a Man more pithecoid, than any yet known await the researches of some unborn paleontologist?

Time will show. But, in the meanwhile, if any form of the doctrine of progressive development is correct, we must extend by long epochs the most liberal estimate that has yet been made of the antiquity of Man.

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[1] *Decas Collectionis suæ craniorum diversarun gentium illustrata.*– Gottingæ, 1790-1820.

[2] In a subsequent passage, Schmerling remarks upon the occurrence of an incisor tooth "of enormous size" from the caverns of Engihoul. The tooth figured is somewhat long, but its dimensions do not appear to me to be otherwise remarkable.

[3] The figure of this clavicle measures 5 inches from end to end in a straight line–so that the bone is rather a small than a large one.

[4] *On the crania of the most Ancient Races of Man.*–By Professor D. Schaaffhausen, of Bonn. (From Müller's Archiv., 1858, pp. 453.) With Remarks, and original Figures, taken from a Cast of the Neanderthal Cranium. By George Busk, F.R.S., &c. *Natural History Review,* April, 1861.

[5] *Verhandl. d. Naturhist. Vereins der preuss. Rheinlande und Westphalens,* xiv.–Bonn, 1857.

[6] *Ib.* Correspondenzblatt. No. 2.

[7] This, Mr. Busk has pointed out, is probably the notch for the frontal nerve.

[8] The numbers in brackets are those which I should assign to the different measures, as taken from the plaster cast.–G.B.

[9] *Verh. des Naturhist.* Vereins in Bonn, xiv. 1857.

[10] Estimating the facial angle in the way suggested, on the cast I should place it at 64° to 67°.–G. B.

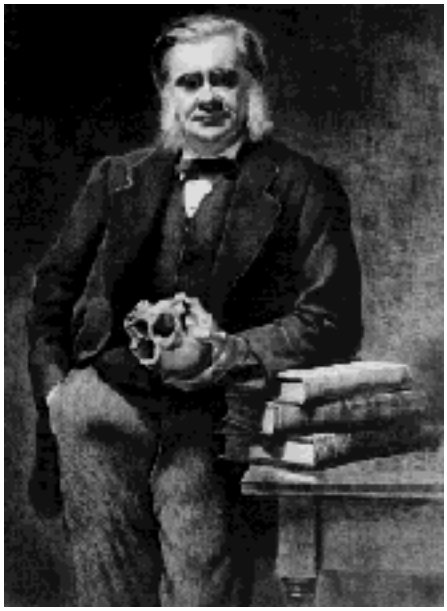
[11] See an excellent Essay by Mr. Church on the Myology of the Orang, in the *Natural History Review* for 1861.

[12] In no normal human skull does the breadth of the braincase exceed its length.

[13] See Dr. D. Wilson's valuable paper "On the supposed prevalence of one Cranial Type throughout the American Aborignes."–*Canadian Journal,* Vol. II, 1857.

[14] [For a further discussion of the characters of the Neanderthal skull, see "Natural History Review," 1864. I there say (p. 443): "That the Neanderthal skull exhibits the lowest type of human cranium at present known, so far as it presents certain pithecoid characters in a more exaggerated form than any other: but that, inasmuch as a complete series of gradations can be found, among recent human skulls, between it and the best developed forms, there is no ground for separating its possessor specifically, still less generically, from *Homo sapiens.* At present, we have no sufficient warranty for declaring it to be either the type of a distinct race, or a member of any existing one; nor do the anatomical characters of the skull justify any conclusion as to the age to which it belongs." See also the essay on the Aryan question in this volume. 1894.]

THE HUXLEY FILE



Preface and Table of Contents to Volume VII, *Man's Place in Nature,* of Huxley's *Collected Essays.*

Next article: On the Methods and Results of Ethnology [1865], pages 209-252.

Previous article: On the Relations of Man to the Lower Animals, pages 77-156.

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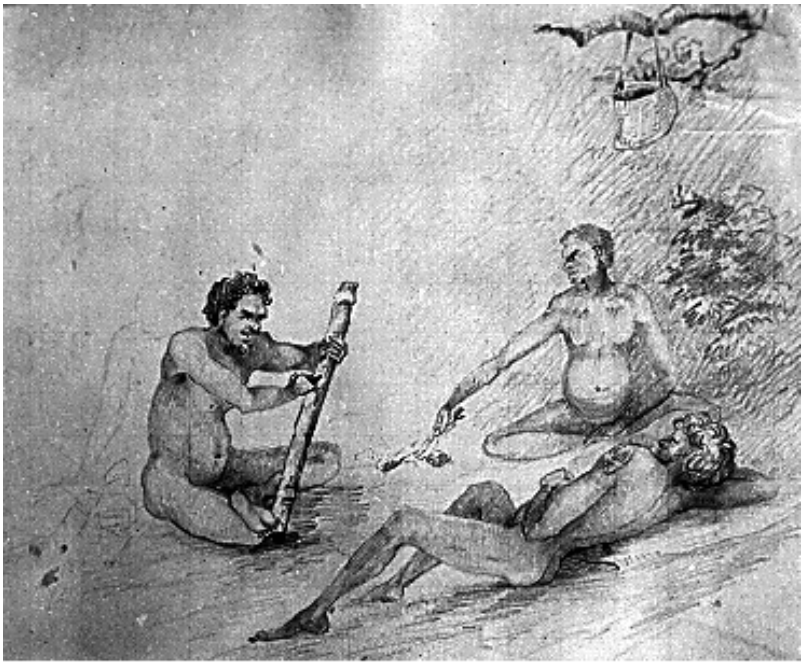

Trio of Papuans Chatting

T. H. H. Sketch - New Guinea May 1849

Huxley Archives

On the Methods and Results of Ethnology (1865)

Collected Essays VII

[209] Ethnology is the science which determines the distinctive characters of the persistent modifications of mankind; which ascertains the distribution of those modifications in present and past times, and seeks to discover the causes, or conditions of existence, both of the modifications and of their distribution. I say "persistent" modifications, because, unless incidentally, ethnology has nothing to do with chance and transitory peculiarities of human structure. And I speak of "persistent modifications" or "stocks" rather than of "varieties," or "races," or "species," because each of these last well-known terms implies, on the part of its employer, a preconceived opinion touching one of those problems, the, solution of which is the ultimate object of the [210] science; and in regard to which, therefore, etymologists are especially bound to keep their minds open and their judgments freely balanced.

Ethnology, as thus defined, is a branch of Anthropology, the great science which unravels the complexities of human structure; traces out the relations of man to other animals; studies all that is especially human in the mode in which man's complex functions are performed; and searches after the conditions which have determined his presence in the world. And anthropology is a section of Zoology,

which again is the animal half of Biology–the science of life and living things.

Such is the position of ethnology, such are the objects of the ethnologist. The paths or methods, by following which he may hope to reach his goal, are diverse. He may work at man from the point of view of the pure zoologist, and investigate the anatomical and physiological peculiarities of Negroes, Australians, or Mongolians, just as he would inquire into those of pointers, terriers, and turnspits,–"persistent modifications" of man's almost universal companion. Or he may seek aid from researches into the most human manifestation of humanity–Language; and assuming that what is true of speech is true of the speaker–a hypothesis as questionable in science as it is in ordinary life–he may apply to mankind themselves the conclusions drawn from a search[211]ing analysis of their words and grammatical forms.

Or, the ethnologist may turn to the study of the practical life of men; and relying upon the inherent conservatism and small inventiveness of untutored mankind, he may hope to discover in manners and customs, or in weapons, dwellings, and other handiwork, a clue to the origin of the resemblances and differences of nations. Or, he may resort to that kind of evidence which is yielded by History proper, and consists of the beliefs of men concerning past events, embodied in traditional, or in written, testimony. Or, when that thread breaks, Archæology, which is the interpretation of the unrecorded remains of man's works, belonging to the epoch since the world has reached its present condition, may still guide him. And, when even the dim light of archæology fades, there yet remains Palæontology, which, in these latter years, has brought to daylight once more the exuvia of ancient populations, whose world was not our world, who have been buried in river beds immemorially dry, or carried by the rush of waters into caves, inaccessible to inundation since the dawn of tradition.

Along each, or all, of these paths the ethnologist may press towards his goal; but they are not equally straight, or sure, or easy to tread. The way of palæontology has but just been laid open to us. Archæological and historical investigations [212] are of great value for all those peoples whose ancient state has differed widely from their present condition, and who have the good or evil fortune to possess a history. But on taking a broad survey of the world, it is astonishing how few nations present either condition. Respecting five-sixths of the persistent modifications of mankind, history and archæology are absolutely silent. For half the rest, they might as well be silent for anything that is to be made of their testimony. And, finally, when the question arises as to what was the condition of mankind more than a paltry two or three thousand years ago, history and archæology are, for the most part, mere dumb dogs. What light does either of these branches of knowledge throw on the past of the man of the New World, if we except the Central Americans and the Peruvians; on that of the Africans, save those of the Valley of the Nile and a fringe of the Mediterranean; on that of all the Polynesian, Australian, and central Asiatic peoples, the former of whom probably, and the last certainly, were, at the dawn of history, substantially what they are now? While thankfully accepting what history has to give him, therefore, the ethnologist must not look for too much from her.

Is more to be expected from inquiries into the customs and handicrafts of man? It is to be feared not. In reasoning from identity of custom to identity of stock the difficulty always obtrudes itself, [213] that the minds of men being everywhere similar, differing in quality and quantity but not in kind of faculty, like

circumstances must tend to produce like contrivances; at any rate, so long as the need to be met and conquered is of a very simple kind. That two nations use calabashes or shells for drinking-vessels, or that they employ spears, or clubs, or swords and axes of stone and metal as weapons and implements, cannot be regarded as evidence that these two nations had a common origin, or even that intercommunication ever took place between them; seeing that the convenience of using calabashes or shells for such purposes, and the advantage of poking an enemy with a sharp stick, or hitting him with a heavy one, must be early forced by nature upon the mind of even the stupidest savage. And when he had found out the use of a stick, he would need no prompting to discover the value of a chipped or whetted stone, or of an angular piece of native metal, for the same object. On the other hand, it may be doubted, whether the chances are not greatly against independent peoples arriving at the manufacture of a boomerang, or of a bow; which last, if one comes to think of it, is a rather complicated apparatus; and the tracing of the distribution of inventions as complex as these, and of such strange customs as betel-chewing and tobacco-smoking, may afford valuable ethnological hints.

[214] Since the time of Leibnitz, and guided by such men as Humboldt, Abel Remusat, and Klaproth, Philology has taken far higher ground. Thus Prichard affirms that "the history of nations, termed Ethnology, must be mainly founded on the relations of their languages."

An eminent living philologer, August Schleicher, in a recent essay, puts forward the claims of his science still more forcibly:–

"If, however, language is the human [distinguishing feature], the suggestion arises whether it should not form the basis of any scientific systematic arrangement of mankind; whether the foundation of the natural classification of the genus Homo has not been discovered in it.

"How little constant are cranial peculiarities and other so-called race characters! Language, on the other hand, is always a perfectly constant diagnostic. A German may occasionally compete in hair and prognathism with a negro, but a negro language will never be his mother tongue. Of how little importance for mankind the so-called race characters are, is shown by the fact that speakers of languages belonging to one and the same linguistic family may exhibit the peculiarities of various races. Thus the settled Osmanli Turk exhibits Caucasian characters, whilst other so-called Tartaric Turks exemplify the Mongol type. On the other hand, the Magyar and the Basque do not depart in any essential physical peculiarity from the Indo-Germans, whilst the Magyar, Basque, and Indo-Germanic tongues are widely different. Apart from their inconstancy, again, the so-called race characters can hardly yield a scientifically natural system. Languages, on the other hand, readily fall into a natural arrangement, like that of which other vital products are susceptible, especially when viewed from their morphological side.... The externally visible structure of the cerebral and facial skeletons, and of the body generally, is less important than that no less material but [215] infinitely more delicate corporeal structure, the function of which is speech. I conceive, therefore, that the natural classification of languages, is also the natural classification of mankind. With language, moreover, all the higher manifestations of man's vital activity are closely interwoven, so that these receive due recognition in and by that of speech."[1]

Without the least desire to depreciate the value of philology as an adjuvant to ethnology, I must venture to doubt, with Rudolphi, Desmoulins, Crawfurd, and others, its title to the leading position claimed for it by the writers whom I have just quoted. On the contrary, it seems to me obvious that, though, in the

absence of any evidence to the contrary, unity of languages may afford a certain presumption in favour of the unity of stock of the peoples speaking those languages, it cannot be held to prove that unity of stock, unless philologers are prepared to demonstrate, that no nation can lose its language and acquire that of a distinct nation, without a change of blood corresponding with the change of language. Desmoulins long ago put this argument exceedingly well:–

"Let us imagine the recurrence of one of those slow, or sudden, political revolutions, or say of those secular changes which among different people and at different epochs have annihilated historical monuments and even extinguished tradition. In that case, the evidence, now so clear, that the negroes of Hayti were slaves imported by a French colony, who, by the [216] very effect of the subordination involved in slavery lost their own diverse languages and adopted that of their masters, would vanish. And metaphysical philosophers, observing the identity of Haytian French with that spoken on the shores of the Seine and the Loire, would argue that the men of St. Domingo with woolly heads, black and oily skins, small calves, and slightly bent knees, are of the same race, descended from the same parental stock, as the Frenchmen with silky brown, chestnut, or fair hair, and white skins. For they would say, their languages are more similar than French is to German or Spanish."[2]

It must not be imagined that the case put by Desmoulins is a merely hypothetical one. Events precisely similar to the transport of a body of Africans to the West India Islands, indeed, cannot have happened among uncivilised races, but similar results have followed the importation of bodies of conquerors among an enslaved people over and over again. There is hardly a country in Europe in which two or more nations speaking widely different tongues have not become intermixed; and there is hardly a language of Europe of which we have any right to think that its structure affords a just indication of the amount of that intermixture.

As Dr. Latham has well said:–

"It is certain that the language of England is of Anglo-Saxon origin, and that the remains of the original Keltic are unimportant. It is by no means so certain that the blood of Englishmen is equally Germanic. A vast amount of Kelticism, [217] not found in our tongue, very probably exists in our pedigrees. The ethnology of France is still more complicated. Many writers make the Parisian a Roman on the strength of his language; whilst others make him a Kelt on the strength of certain moral characteristics, combined with the previous Kelticism of the original Gauls. Spanish and Portuguese, as languages, are derivations from the Latin; Spain and Portugal, as countries, are Iberic, Latin, Gothic, and Arab, in different proportions. Italian is modern Latin all the world over; yet surely there must be much Keltic blood in Lombardy, and much Etruscan intermixture in Tuscany.

"In the ninth century every man between the Elbe and the Niemen spoke some Slavonic dialect; they now nearly all speak German. Surely the blood is less exclusively Gothic than the speech."[3]

In other words, what philologer, if he had nothing but the vocabulary and grammar of the French and English languages to guide him, would dream of the real causes of the unlikeness of a Norman to a Provençal, of an Orcadian to a Cornishman? How readily might he be led to suppose that the different climatal conditions to which these speakers of one tongue have so long been exposed, have caused their physical differences; and how little would he suspect that these are due (as we happen to know they are)

to wide differences of blood.

Few take duly into account the evidence which exists as to the ease with which unlettered savages gain or lose a language. Captain Erskine, in his interesting "Journal of a Cruise among the Islands of the Western Pacific," especially remarks [218] upon the "avidity with which the inhabitants of the polyglot islands of Melanesia, from New Caledonia to the Solomon Islands, adopt the improvements of a more perfect language than their own, which different causes and accidental communication still continue to bring to them;" and he adds that "among the Melanesian islands scarcely one was found by us which did not possess, in some cases still imperfectly, the decimal system of numeration in addition to their own, in which they reckon only to five."

Yet how much philological reasoning in favour of the affinity or diversity of two distinct peoples has been based on the mere comparison of numerals!

But the most instructive example of the fallacy which may attach to merely philological reasonings, is that afforded by the Feejeans, who are, physically, so intimately connected with the adjacent Negritos of New Caledonia, &c., that no one can doubt to what stock they belong, and who yet, in the form and substance of their language, are Polynesian. The case is as remarkable as if the Canary Islands should have been found to be inhabited by negroes speaking Arabic, or some other clearly Semitic dialect, as their mother tongue. As it happens, the physical peculiarities of the Feejeans are so striking, and the conditions under which they live are so similar to those of the Polynesians, that no one [219] has ventured to suggest that they are merely modified Polynesians–a suggestion which could otherwise certainly have been made. But if languages may be thus transferred from one stock to another, without any corresponding intermixture of blood, what ethnological value has philology?–what security does unity of language afford us that the speakers of that language may not have sprung from two, or three, or a dozen, distinct sources?

Thus we come, at last, to the purely zoological method, from which it is not unnatural to expect more than from any other, seeing that, after all, the problems of ethnology are simply those which are presented to the zoologist by every widely distributed animal he studies. The father of modern zoology seems to have had no doubt upon this point. At the twenty-eighth page of the standard twelfth edition of the "Systema Naturæ," in fact, we find:–

I. Primates

Dentes primores incisores: superiores IV. paralleli, mammæ pectorales II.

1. Homo.	Nosce te ipsum.
Sapiens.	1. H. diurnus: *varians cultura, loco. Ferus.* Tetrapus, mutus, hirsutus.

. . . . . .

Americanus α Rufus, cholericus, rectus–*Pilis* nigris, rectis, crassis–*Naribus* patulis–*Facie* ephelitica: *Mento* subimberbi.
Pertinax, contentus, liber. *Pingit* se lineis dædaleis rubris.
Regitur, Consuetudine.

Europæus β. Allus sanguineus torosus. *Pilis* flavescentibus, prolixis.
Oculis cœruleis.
Levis, argutus, inventor. *Tegitur* Vestimentis arctis. *Regitur* Ritbus.

Asiaticus γ. Luridus, melancholicus, rigidus. *Pilis* nigricoantibus. *Oculis* fuscis. *Severus,* fastuosus, avarus.
Tegitur Indulmentis laxis.
Regitur Opinionibus.

Afer δ. Niger, phlegmaticus, laxus. *Pilis* atris, contortuplicatis. *Cute* holosericea. *Naso* simo. *Labiis* tumidis. *Feminis* sinus pudoris.
Mammæ lactantes prolixæ.
Vafer, segnis, negligens. *Ungit* se pingui. *Regitur* Arbitrio.

Monstrosus ε. Solo (a) et arte (b c) variat.:
a. *Alpini* parvi, agiles, timidi.
Patagonici magni, segnes.
b. *Monorchides* ut minus fertiles: Hottentotti.
Junceæ puellæ, abdomine attenuato: Europææ.
c. *Macrocephali* capiti conico: Chinenses.
Plagiocephali capite antice compresso: Canadenses.

Turn a few pages further on in the same volume, and there appears, with a fine impartiality in the distribution of capitals and sub-divisional headings:–

III. Feræ.

Dentes primores superiores sex,acutiusculi. Canini solitarii.

. . . . . .

12. Canis. *Dentes primores superiores* VI.: laterales longiores distantes; intermedii lobati. Inferiores VI.: laterales lobati. Inferiores VI.: laterales lobati.
Laniarii solitarii, incurvati.
Molares VI. s. VII (pluresve quam in reliquis.)

[221]

familiaris 1. C. cauda (sinistrorsum) recurvata . . . .

domesticus α. auriculis erectis, cauda subtus lanata.

sagax β. auriculis pendulis, digito spurio ad tibias posticas.

grajus γ. magnitudine lupi, trunco curvato, rostro attentuato, &c. &c.

Linnæus' definition of what he considers to be mere varieties of the species Man are, it will be observed, as completely free from any illusion to linguistic peculiarities as those brief and pregnant sentences in

which he sketches the characters of the varieties of the species Dog. "Pilis nigris, naribus patulis" may be set against "auriculis erectis, cauda subtus lanata;" while the remarks on the morals and manners of the human subject seem as if they were thrown in merely by way of makeweight.

Buffon, Blumenbach (the founder of ethnology as a special science), Rudolphi, Bory de St. Vincent, Desmoulins, Cuvier, Retzius, indeed I may say all the naturalists proper, have dealt with man from a no less completely zoological point of view; while, as might have been expected, those who have been least naturalists, and most linguists, have most neglected the zoological method, the neglect culminating in those who have been altogether devoid of acquaintance with anatomy.

Prichard's proposition, that language is more persistent than physical characters, is one which [222] has never been proved, and indeed admits of no proof, seeing that the records of language do not extend so far as those of physical characters. But, until the superior tenacity of linguistic over physical peculiarities is shown, and until the abundant evidence which exists, that the language of a people may change without corresponding physical change in that people, is shown to be valueless, it is plain that the zoological court of appeal is the highest for the ethnologist, and that no evidence can be set against that derived from physical characters.

What, then, will a new survey of mankind from the Linnean point of view teach us?

The great antipodal block of land we call Australia has, speaking roughly, the form of a vast quadrangle, 2,000 miles on the side, and extends from the hottest tropical, to the middle of the temperate, zone. Setting aside the foreign colonists introduced within the last century, it is inhabited by people no less remarkable for the uniformity, than for the singularity, of their physical characters and social state. For the most part of fair stature, erect and well built, except for an unusual slenderness of the lower limbs, the Australians have dark, usually chocolate-coloured skins; fine dark wavy hair; dark eyes, overhung by beetle brows; coarse, projecting jaws; broad and dilated, but not especially flattened, [223] noses, and lips which, though prominent, are eminently flexible.

The skulls of these people are always long and narrow, with a smaller development of the frontal sinuses than usually corresponds with such largely developed brow ridges. An Australian skull of a round form, or one the transverse diameter of which exceeds eight-tenths of its length, has never been seen. These people, in a word, are eminently "dolichocephalic," or long-headed; but, with this one limitation, their crania present considerable variations, some being comparatively high and arched, while others are more remarkably depressed than almost any other human skulls. The female pelvis differs comparatively little from the European; but in the pelves of male Australians which I have examined, the antero-posterior and transverse diameters approach equality more nearly than is the case in Europeans.

No Australian tribe has ever been known to cultivate the ground,[4] to use metals, pottery, or any kind of textile fabric. They rarely construct huts. Their means of navigation are limited to rafts or canoes, made of sheets of bark. Clothing, except skin cloaks for protection from cold, is a superfluity with which they dispense; and though they have some singular weapons, almost peculiar [224] to themselves, they are

wholly unacquainted with bows and arrows.

It is but a step, as it were, across Bass's Straits to Tasmania. Neither climate nor the characteristic forms of vegetable or animal life change largely on the south side of the Straits, but the early voyagers found Man singularly different from him on the north side. The skin of the Tasmanian was dark, though he lived between parallels of latitude corresponding with those of middle Europe in our own hemisphere; his jaws projected, his head was long and narrow; his civilization was about on a footing with that of the Australian, if not lower, for I cannot discover that the Tasmanian understood the use of the throwing-stick. But he differed from the Australian in his woolly, negro-like hair; whence the name of Negrito, which has been applied to him and his congeners.

Such Negritos–differing more or less from the Tasmanian but agreeing with him in dark skin and woolly hair–occupy New Caledonia, the New Hebrides, the Louisiade Archipelago; and stretching to the Papuan Islands, and for a doubtful extent beyond them to the north and west, form a sort of belt, or zone, of Negrito population, interposed between the Australians on the west and the inhabitants of the great majority of the Pacific islands on the east.

The cranial characters of the Negritos vary considerably more than those of their skin and hair, [225] the most notable circumstance being the strong Australian aspect which distinguishes many Negrito skulls, while others tend rather towards forms common in the Polynesian islands.

In civilization, New Caledonia exhibits an advance upon Tasmania and, farther north, there is a still greater improvement. But the bows and arrows, the perched houses, the outrigger canoes, the habits of betel-chewing and of kawa-drinking, which abound more or less among the northern Negritos, are probably to be regarded not as the products of an indigenous civilization, but merely as indications of the extent to which foreign influences have modified the primitive social state of these people.

From Tasmania or New Caledonia, to New Zealand or Tongataboo, is again but a brief voyage: but it brings about a still more notable change in the aspect of the indigenous population than that effected by the passage of Bass's Straits. Instead of being chocolate-coloured people, the Maories and Tongans are light brown; instead of woolly, they have straight, or wavy, black hair. And if from New Zealand, we travel some 5,000 miles east to Easter Island; and from Easter Island, for as great a distance northwest, to the Sandwich Islands; and thence 7,000 miles, westward and southward, to Sumatra; and even across the Indian Ocean, into the interior of Madagascar, we shall everywhere meet with people whose hair is [226] straight or wavy, and whose skins exhibit various shades of brown. These are the Polynesians, Micronesians, Indonesians, whom Latham has grouped together under the common title of Amphinesians.

The cranial characters of these people, as of the Negritos, are less constant than those of their skin and hair. The Maori has a long skull; the Sandwich Islander a broad skull. Some, like these, have strong brow ridges; others like the Dayaks and many Polynesians, have hardly any nasal indentation. It is only in the westernmost parts of their area that the Amphinesian nations know anything about bows and

arrows as weapons, or are acquainted with the use of metals or with pottery. Everywhere they cultivate the ground, construct houses, and skilfully build and manage outrigger, or double, canoes; while, almost everywhere, they use some kind of fabric for clothing.

Between Easter Island, or the Sandwich Islands, and any part of the American coast is a much wider interval than that between Tasmania and New Zealand, but the ethnological interval between the American and the Polynesian is less than that between either of the previously named stocks.

The typical American has straight black hair and dark eyes, his skin exhibiting various shades of reddish or yellowish brown, sometimes inclining to olive. The face is broad and scantily bearded; [227] the skull wide and high. Such people extend from Patagonia to Mexico, and much farther north along the west coast. In the main a race of hunters, they had nevertheless, at the time of the discovery of the Americas, attained a remarkable degree of civilization in some localities. They had domesticated ruminants, and not only practised agriculture, but had learned the value of irrigation. They manufactured textile fabrics, were masters of the potter's art, and knew how to erect massive buildings of stone. They understood the working of the precious, though not of the useful, metals;[5] and had even attained to a rude kind of hieroglyphic, or picture, writing. The Americans not only employ the bow and arrow, but, like some Amphinesians, the blow-pipe, as offensive weapons: but I am not aware that the outrigger canoe has ever been observed among them.

I have reason to suspect that some of the Fuegian tribes differ cranially from the typical Americans;[6] and the Northern and Eastern American tribes have longer skulls than their Southern compatriots. But the Esquimaux, who roam on the desolate and ice-bound coast of Arctic America, certainly present us with a new stock. The Esquimaux (among whom the Greenlanders are included), in fact, though they share the straight [228] black hair of the proper Americans, are generally a duller complexioned, shorter, and a more squat people, and they have still more prominent cheekbones. But the circumstance which most completely separates them from the typical Americans, is the form of their skulls, which instead of being broad, high, and truncated behind, are eminently long, usually low, and prolonged backwards. These Hyperborean people clothe themselves in skins, know nothing of pottery, and hardly anything of metals. Dependent for existence upon the produce of the chase, the seal and the whale are to them what the cocoa-nut tree and the plantain are to the savages of more genial climates. Not only are those animals meat and raiment, but they are canoes, sledges, weapons, tools, windows, and fire; while they support the dog, who is the indispensable ally and beast of burden of the Esquimaux.

It is admitted that the Tchuktchi, on the eastern side of Behring's Straits, are, in all essential respects, Esquimaux; and I do not know that there is any satisfactory evidence to show that the Tunguses and Samoiedes do not essentially share the same physical characters. Southward, there are indications of Esquimaux characters among the Japanese, and it is possible that their influence may be traced yet further.

However this may be, Eastern Asia, from Mantchouria to Siam, Thibet, and Northern Hindostan, [229] is continuously inhabited by men, usually of short stature, with skins varying in colour from yellow to

olive; with broad cheek-bones and faces that, owing to the insignificance of the nose, are exceedingly flat; and with small, obliquely-set[7] black eyes and straight black hair, which sometimes attains a very great length upon the scalp, but is always scanty upon the face and body. The skull, never much elongated, is, generally, remarkably broad and rounded, with hardly any nasal depression, and but slight, if any, projection of the jaws. Many of these people, for whom the old name of Mongolians may be retained, are nomades; others, as the Chinese, have attained a remarkable and apparently indigenous civilization, only surpassed by that of Europe.

At the north-western extremity of Europe the Lapps repeat the characters of the Eastern Asiatics. Between these extreme points, the Mongolian stock is not continuous, but is represented by a chain of more or less isolated tribes, who pass under the name of Calmucks and Tartars, and form Mongolian islands, as it were, in the midst of an ocean of other people.

The waves of this ocean are the nations for whom, in order to avoid the endless confusion produced by our present half-physical, half-philo[230]logical classification, I shall use a new name–Xanthochroi–indicating that they are "yellow" haired and "pale" in complexion. The Chinese historians of the Han dynasty, writing in the third century before our era, describe, with much minuteness, certain numerous and powerful barbarians with "yellow hair, green eyes, and prominent noses," who, the black-haired, skew-eyed, and flat-nosed annalists remark in passing, are "just like the apes from whom they are descended." These people held, in force, the upper waters of the Yenisei, and thence under various names stretched southward to Thibet and Kashgar. Fair-haired and blue-eyed northern enemies were no less known to the ancient Hindoos, to the Persians, and to the Egyptians, on the south and west of the great central Asiatic area; while the testimony of all European antiquity is to the effect that, before and since the period in question there lay beyond the Danube, the Rhine, and the Seine, a vast and dangerous yellow or red-haired, fair-skinned, blue-eyed population. Whether the disturbers of the marches of the Roman Empire were called Gauls or Germans, Goths, Alans, or Scythians, one thing seems certain, that until the invasion of the Huns, they were largely tall, fair, blue-eyed men.

If any one should think fit to assume that, in the year 100 B.C., there was one continuous Xanthochroic population from the Rhine to the [231] Yenisei, and from the Ural mountains to the Hindoo Koosh, I know not that any evidence exists by which that position could be upset, while the existing state of things is rather in its favour than otherwise. For the Scandinavians, the Germans, the Slavonian and the Finnish tribes, to a great extent; some of the inhabitants of Greece, many Turks, some Kirghis, and some Mantchous, the Ossetes in the Caucasus, the Siahposh, the Rohillas, are at the present day fair, yellow or red-haired, and blue-eyed; and the interpolation of tribes of Mongolian hair and complexion, as far west as the Caspian Steppes and the Crimea, might justly be accounted for by those subsequent westward eruptions of the Mongolian stock, of which history furnishes abundant testimony. The furthermost limit of the Xanthochroi north westward is Iceland and the British Isles; southwestward, they are traceable at intervals through Syria and the Berber country, ending in the Canary Islands. The cranial characters of the Xanthochroi are not, at present, strictly definable. The Scandinavians are certainly long-headed; but many Germans, the Swiss so far as they are Germanized, the Slavonians, the Fins, and the Turks, are

short-headed. What were the cranial characters of the ancient "U-suns" and "Tinglings" of the valley of the Yenisei is unknown.

West and south of the area occupied by the chief mass of the Xanthochroi, and north of the [232] Sahara, is a broad belt of land, shaped like a >-. Between the forks of the Y lies the Mediterranean, the stem of it is Arabia. The stem is bathed by the Indian Ocean, the western ends of the forks by the Atlantic. The majority of the people inhabiting the area thus roughly defined have, like the Xanthochroi, prominent noses, pale skins and wavy hair, with abundant beards; but, unlike them, the hair is black or dark and the eyes usually so. They may thence be called the Melanochroi. Such people are found in the British Islands, in Western and Southern Gaul, in Spain, in Italy south of the Po, in parts of Greece, in Syria and Arabia, stretching as far northward and eastward as the Caucasus and Persia. They are the chief inhabitants of Africa north of the Sahara, and, like the Xanthochroi, they end in the Canary Islands. They are known as Kelts, Iberians, Etruscans, Romans, Pelasgians, Berbers, Semites. The majority of them are long-headed, and of smaller stature than the Xanthochroi.[8] It is needless to remark upon the civilization of these two great stocks. With them has originated everything that is highest in science, in art, in law in politics, and in mechanical inventions. In their hands, at the present moment, lies the order of the social world, and to them its progress is committed.

South of the Atlas, and of the Great Desert, [233] Middle Africa exhibits a new type of humanity in the Negro, with his dark skin, woolly hair, projecting jaws, and thick lips. As a rule, the skull of the Negro is remarkably long; it rarely approaches the broad type, and never exhibits the roundness of the Mongolian. A cultivator of the ground, and dwelling in villages; a maker of pottery, and a worker in the useful as well as the ornamental metals; employing the bow and arrow as well as the spear, the typical negro stands high in point of civilization above the Australian.

Resembling the Negroes in cranial characters, the Bushmen of South Africa differ from them in their yellowish brown skins, their tufted hair, their remarkably small stature, and their tendency to fatty and other integumentary outgrowths; nor is the wonderful click with which their speech is interspersed to be overlooked in enumerating the physical characteristics of this strange people.

The so-called "Dravidian" populations of Southern Hindostan lead us back, physically as well as geographically, towards the Australians;[9] [234] while the diminutive Mincopies of the Andaman Islands lie midway between the Negro and Negrito races, and, as Mr. Busk has pointed out, occasionally present the rare combination of brachycephaly, or short-headedness, with woolly hair.

In the preceding progress along the outskirts of the habitable world, eleven readily distinguishable stocks, or persistent modifications, of mankind, have been recognized. I have purposely omitted such people as the Abyssinians and the Hindoos of the valleys of the Ganges and Indus, who there is every reason to believe result from the intermixture of distinct stocks. Perhaps I ought for like reasons, to have ignored the Mincopies. But I do not pretend that my enumeration is complete or, in any sense, perfect. It is enough for my purpose if it be admitted (and I think it cannot be denied) that those which I have mentioned exist, are well marked, and occupy the greater part of the habitable globe.

In attempting to classify these persistent modifications after the manner of naturalists, the first circumstance that attracts one's attention is the broad contrast between the people with straight and wavy hair, and those with crisp, woolly, or tufted hair. Bory de St. Vincent, noting this fundamental distinction, divided mankind accordingly into the two primary groups of *Leiotrichi* and *Ulotrichi*,– terms which are open to criticism, [235] but which I adopt in the accompanying table, because they have been used. It is better for science to accept a faulty name which has the merit of existence, than to burthen it with a faultless newly invented one.

Under each of these divisions are two columns, one for the Brachycephali, or short heads, and one for the Dolichocephali,[10] or long heads. Again, each column is subdivided transversely into four compartments, one for the "leucous," people with fair complexions and yellow or red hair; one for the "leucomelanous," with dark hair and pale skins; one for the "xanthomelanous," with black hair and yellow, brown, or olive skins; and one for the "melanous," with black hair and dark brown or blackish skins.

Leiotrichi.		Ulotrichi.	
Dolichocephali.	Brachycephali	Dolichocephai.	Brachycephali.
Leucous.			
. . . Xanthrochroi . . .			
Leucomelanous.			
. . . Melanochro . . .			
Xanthomelanous.			
Equimaux. Mongolians.		*Bushmen.*	
Amphinesians.			
Americans.			
Melanous.			
Australians.		Negroes *Mincopies* (?)	
		Negritos.	

** The names of the stocks known only since the fifteenth century are put into italics. If the "Skrälings" of the Norse discovery of America were Esquimaux, Europeans became acquainted with the later six or seven centuries earlier.*

[236] It is curious to observe that almost all the woolly-haired people are also long-headed; while among the straight-haired nations broad heads preponderate, and only two stocks, the Esquimaux and the Australians, are exclusively long-headed.

One of the acutest and most original of ethnologists, Desmoulins, originated the idea, which has

subsequently been fully developed by Agassiz, that the distribution of the persistent modifications of man is governed by the same laws as that of other animals, and that both fall into the same great distributional provinces. Thus, Australia; America, south of Mexico; the Arctic regions; Europe, Syria, Arabia, and North Africa, taken together, are each regions eminently characterized by the nature of their animal and vegetable populations, and each, as we have seen, has its peculiar and characteristic form of man. But it may be doubted whether the parallel thus drawn will hold good strictly, and in all cases. The Tasmanian Fauna and Flora are essentially Australian, and the like is true, to a less extent, of many, if not of all, the Papuan islands; but the Negritos who inhabit these islands are strikingly different from the Australians. Again, the differences between the Mongolians and the Xanthochroi are out of all proportion greater than those [238] between the Faunæ and Floræ of Central and Eastern Asia. But whatever the difficulties in the way of the detailed application of this comparison of the distribution of men with that of animals, it is well worthy of being borne in mind, and carried as far as it will go.

Apart from all speculation, a very curious fact regarding the distribution of the persistent modifications of mankind becomes apparent on inspecting an Ethnological chart, projected in such a manner that the Pacific Ocean occupies its centre. Such a chart exhibits an Australian area occupied by dark smooth-haired people, separated by an incomplete inner zone of dark woolly-haired Negritos and Negroes, from an outer zone of comparatively pale and smooth-haired men, occupying the Americas, and nearly all Asia[11] and North Africa.[12]

Such is a brief sketch of the characters and distribution of the persistent modifications, or stocks, of mankind at the present day. If we seek for direct evidence of how long this state of things has lasted, we shall find little enough, and that little far from satisfactory. Of the eleven different stocks enumerated, seven have been known to us for less than 400 years; and of these seven not one possessed a fragment of written history at the [238] time it came into contact with European civilization. The other four–the Negroes, Mongolians, Xanthochroi, and Melanochroi–have always existed in some of the localities in which they are now found, nor do the negroes ever seem to have voluntarily travelled beyond the limits of their present area. But ancient history is in a great measure the record of the mutual encroachments of the other three stocks.

On the whole, however, it is wonderful how little change has been effected by these mutual invasions and intermixtures. As at the present time, so at the dawn of history the Melanochroi fringed the Atlantic and the Mediterranean; the Xanthochroi occupied most of Central and Eastern Europe, and much of Western and Central Asia; while Mongolians held the extreme east of the Old World. So far as history teaches us, the populations of Europe, Asia and Africa were, twenty[13] centuries ago, just what they are now, in their broad features and general distribution.

The evidence yielded by Archæology is not very definite, but so far as it goes, it is to much the same effect. The mound builders of Central America seem to have had the characteristic short and broad head of the modern inhabitants of that continent. The tumuli and tombs of Ancient Scandinavia, of pre-Roman Britain, of Gaul, of [239] Switzerland, reveal two types of skull–a broad and a long–of which, in Scandinavia, the broad seems to have belonged to the older stock, while the reverse was probably the

case in Britain, and certainly in Switzerland. It has been assumed that the broad-skulled people of ancient Scandinavia were Lapps; but there is no proof of the fact, and they may have been, like the broad-skulled Swiss and Germans, Xanthochroi. One of the greatest of ethnological difficulties is to know where the modern Swedes, Norsemen, and Saxons got their long heads, as all their neighbours, Fins, Lapps, Slavonians, and South Germans, are broad-headed. Again, who were the small-handed[14] long-headed people of the "bronze epoch," and what has become of the infusion of their blood among the Xanthochroi?

At present Paleontology yields no safe data to the ethnologist. We know absolutely nothing of the ethnological characters of the men of Abbeville and Hoxne; but must be content with the demonstration, in itself of immense value, that Man existed in Western Europe when its physical condition was widely different from what it is now, and when animals existed, which, though they belong to what is, properly speaking, the present [240] order of things, have long been extinct. Beyond the limits of a fraction of Europe, Palæontology tells us nothing of man or of his works.

To sum up our knowledge of the ethnological past of man; so far as the light is bright, it shows him substantially as he is now; and, when it grows dim, it permits us to see no sign that he was other than he is now.

It is a general belief that men of different stocks differ as much physiologically as they do morphologically; but it is very hard to prove, in any particular case, how much of a supposed national characteristic is due to inherent physiological peculiarities and how much to the influence of circumstances. There is much evidence to show, however, that some stocks enjoy a partial or complete immunity from diseases which destroy, or decimate, others. Thus there seems good ground for the belief that Negroes are remarkably exempt from yellow fever; and that, among Europeans, the melanochroic people are less obnoxious to its ravages than the xanthochroic. But many writers, not content with physiological differences of this kind, undertake to prove the existence of others of far greater moment; and, indeed, to show that certain stocks of mankind exhibit, more or less distinctly, the physiological characters of true species. Unions between these stocks, and still more between the half-breeds arising from their mixture, are affirmed to be [241] either infertile, or less fertile than those which take place between males and females of either stock under the same circumstances. Some go so far as to assert that no mixed breeds of mankind can maintain themselves without the assistance of one or other of the parent stocks, and that, consequently, they must inevitably be obliterated in the long run.

Here, again, it is exceedingly difficult to obtain trustworthy evidence and to free the effects of the pure physiological experiment from adventitious influences. The only trial which, by a strange chance, was kept clear of all such influences–the only instance in which two distinct stocks of mankind were crossed, and their progeny intermarried without any admixture from without–is the famous case of the Pitcairn Islanders, who were the progeny of Bligh's English sailors by Tahitian women. The results of this experiment, as everybody knows, are dead against those who maintain the doctrine of human hybridity, seeing that the Pitcairn Islanders, even though they necessarily contracted consanguineous marriages, throve and multiplied exceedingly.

But those who are disposed to believe in this doctrine should study the evidence brought forward in its support by M. Broca, its latest and ablest advocate, and compare this evidence with that which the botanists, as represented by a Gaertner, or by a Darwin, think it indispensable to obtain [242] before they will admit the infertility of crosses between two allied kinds of plants. They will then, I think, be satisfied that the doctrine in question rests upon a very unsafe foundation; that the facts adduced in its support are capable of many other interpretations; and, indeed, that from the very nature of the case, demonstrative evidence one way or the other is almost unattainable. *A priori,* I should be disposed to expect a certain amount of infertility between some of the extreme modifications of mankind; and still more between the offsprings of their intermixture. *A posteriori*, I cannot discover any satisfactory proof that such infertility exists.

From the facts of ethnology I now turn to the theories and speculations of ethnologists, which have been devised to explain these facts, and to furnish satisfactory answers to the inquiry–what conditions have determined the existence of the persistent modifications of mankind, and have caused their distribution to be what it is?

These speculations may be grouped under three heads: firstly the Monogenist hypotheses; secondly, those of the Polygenists; and thirdly, that which would result from a simple application of Darwinian principles to mankind.

According to the Monogenists, all mankind have sprung from a single pair, whose multitudinous progeny spread themselves over the world, such as [243] it now is, and became modified into the forms we meet with in the various regions of the earth, by the effect of the climatal and other conditions to which they were subjected.

The advocates of this hypothesis are divisible into several schools. There are those who represent the most numerous, respectable, and would-be orthodox of the public, and are what may be called "Adamites," pure and simple. They believe that Adam was made out of earth somewhere in Asia, about six thousand years ago; that Eve was modelled from one of his ribs; and that the progeny of these two having been reduced to the eight persons who were landed on the summit of Mount Ararat after an universal deluge, all the nations of the earth have proceeded from these last, have migrated to their present localities, and have become converted into Negroes, Australians, Mongolians, &c., within that time. Five-sixths of the public are taught this Adamitic Monogenism, as if it were an established truth, and believe it. I do not; and I am not acquainted with any man of science, or duly instructed person, who does.

A second school of monogenists, not worthy of much attention, attempts to hold a place midway between the Adamites and a third division, who take up a purely scientific position, and require to be dealt with accordingly. This third division, in fact, numbers in its ranks Linnæus, Buffon, [244] Blumenbach, Cuvier, Prichard, and many distinguished living theologians.

These "Rational Monogenists," or, at any rate, the more modern among them, hold, firstly, that the

present condition of the earth has existed for untold ages; secondly, that, at a remote period, beyond the ken of Archbishop Usher, man was created, somewhere between the Caucasus and the Hindoo Koosh; thirdly, that he might have migrated thence to all parts of the inhabited world, seeing that none of them are unattainable from some other inhabited part, by men provided with only such means of transport as savages are known to possess and must have invented; fourthly, that the operation of the existing diversities of climate and other conditions upon people so migrating, is sufficient to account for all the diversities of mankind.

Of the truth of the first of these propositions no competent judge now entertains any doubt. The second is more open to discussion; for, in these latter days, many question the special creation of man: and even if his special creation be granted, there is not a shadow of a reason why he should have been created in Asia rather than anywhere else. Of all the odd myths that have arisen in the scientific world, the "Caucasian mystery," invented quite innocently by Blumenbach, is the oddest. A Georgian woman's skull was the handsomest in his collection. Hence it became [245] his model exemplar of human skulls, from which all others might be regarded as deviations; and out of this, by some strange intellectual hocus-pocus, grew up the notion that the Caucasian man is the prototypic "Adamic" man, and his country the primitive centre of our kind. Perhaps the most curious thing of all is, that the said Georgian skull, after all, is not a skull of average form, but distinctly belongs to the brachycephalic group.

With the third proposition I am quite disposed to agree, though it must be recollected that it is one thing to allow that a given migration is possible, and another to admit there is good reason to believe it has really taken place.

But I can find no sufficient ground for accepting the fourth proposition; and I doubt if it would ever have obtained its general currency except for the circumstance that fair Europeans are very readily tanned and embrowned by the sun. Yet I am not aware that there is a particle of proof that the cutaneous change thus effected can become hereditary, any more than that the enlarged livers, which plague our countrymen in India, can be transmitted; while there is very strong evidence to the contrary. Not only, in fact, are there such cases as those of the English families in Barbadoes, who have remained for six generations unaltered in complexion, but which are open to the objection that they may have received [246] infusions of fresh European blood; but there is the broad fact, that not a single indigenous Negro exists either in the great alluvial plains of tropical South America, or in the exposed islands of the Polynesian Archipelago, or among the populations of equatorial Borneo or Sumatra. No satisfactory explanation of these obvious difficulties has been offered by the advocates of the direct influence of conditions. And as for the more important modifications observed in the structure of the brain, and in the form of the skull, no one has ever pretended to show in what way they can be effected directly by climate.

It is here, in fact, that the strength of the Polygenists, or those who maintain that men primitively arose, not from one, but from many stocks, lies. Show us, they say to the Monogenists, a single case in which the characters of a human stock have been essentially modified without its being demonstrable, or, at least, highly probable, that there has been intermixture of blood with some foreign stock. Bring forward any instance in which a part of the world, formerly inhabited by one stock, is now the dwelling-place of

another, and we will prove the change to be the result of migration, or of intermixture, and not of modification of character by climatic influences. Finally, prove to us that the evidence in favour of the specific distinctness of many animals, admitted to be distinct species by all [247] zoologists, is a whit better than that upon which we maintain the specific distinctness of men.

If presenting unanswerable objections to your adversary were the same thing as proving your own case, the Polygenists would be in a fair way towards victory; but, unfortunately, as I have already observed they have as yet completely failed to adduce satisfactory positive proof of the specific diversity of mankind. Like the Monogenists, the Polygenists are of several sects; some imagine that their assumed species of mankind were created where we find them–the African in Africa, and the Australian in Australia, along with the other animals of their distributional province; others conceive that each species of man has resulted from the modification of some antecedent species of ape–the American from the broad-nosed Simians of the New World, the African from the Troglodytic stock, the Mongolian from the Orangs.

The first hypothesis is hardly likely to win much favour. The whole tendency of modern science is to thrust the origination of things further and farther into the background; and the chief philosophical objection to Adam being, not his oneness, but the hypothesis of his special creation; the multiplication of that objection tenfold is, whatever it may look, an increase, instead of a diminution, of the difficulties of the case. And, as to the second alternative, it may [248] safely be affirmed that, even if the differences between men are specific, they are so small, that the assumption of more than one primitive stock for all is altogether superfluous. Surely no one can now be found to assert that any two stocks of mankind differ as much as a chimpanzee and an orang do; still less that they are as unlike as either of these is to any New World Simian!

Lastly, the granting of the Polygenist premises does not, in the slightest degree, necessitate the Polygenist conclusion. Admit that Negroes and Australians, Negritos and Mongols are distinct species, or distinct genera, it you will, and you may yet, with perfect consistency, be the strictest of Monogenists, and even believe in Adam and Eve as the primeval parents of all mankind.

It is to Mr. Darwin we owe this discovery: it is he who, coming forward in the guise of an eclectic philosopher, presents his doctrine as the key to ethnology, and as reconciling and combining all that is good in the Monogenistic and Polygenistic schools. It is true that Mr. Darwin has not, in so many words, applied his views to ethnology; but even he who "runs and reads" the "Origin of Species" can hardly fail to do so; and, furthermore, Mr. Wallace and M. Pouchet have recently treated of ethnological questions from this point of view. Let me, in conclusion, add my own contribution to the same store.

[249] I assume Man to have arisen in the manner which I have discussed elsewhere, and probably, though by no means necessarily, in one locality. Whether he arose singly, or a number of examples appeared contemporaneously, is also an open question for the believer in the production of species by the gradual modification of pre-existing ones. At what epoch of the world's history this took place, again, we have no evidence whatever. It may have been in the older tertiary, or earlier; but what is most

important to remember is, that the discoveries of late years have proved that man inhabited Western Europe, at any rate, before the occurrence of those great physical changes which have given Europe its present aspect. And as the same evidence shows that man was the contemporary of animals which are now extinct, it is not too much to assume that his existence dates back at least as far as that of our present Fauna and Flora, or before the epoch of the drift.

But if this be true, it is somewhat startling to reflect upon the prodigious changes which have taken place in the physical geography of this planet since man has been an occupant of it.

During that period the greater part of the British islands, of Central Europe, of Northern Asia, have been submerged beneath the sea and raised up again. So has the great desert of Sahara, which occupies the major part of Northern [250] Africa.[15] The Caspian and the Aral seas have been one, and their united waters have probably communicated with both the Arctic and the Mediterranean oceans.[16] The greater part of North America has been under water, and has emerged. It is highly probable that a large part of the Malayan Archipelago has sunk, and that its primitive continuity with Asia has been destroyed. Over the great Polynesian area subsidence has taken place to the extent of many thousands of feet–subsidence of so vast a character, in fact, that if a continent like Asia had once occupied the area of the Pacific, the peaks of its mountains would now show not more numerous than the islands of the Polynesian Archipelago.[17]

What lands may have been thickly populated for untold ages, and subsequently have disappeared and left no sign above the waters, it is of course impossible for us to say; but unless we are to make the wholly unjustifiable assumption that no dry land rose elsewhere when our present dry land sank, there must be half-a-dozen Atlantises beneath the waves of the various oceans of the world. But if the regions which have undergone [251] these slow and gradual, but immense alterations, were wholly or in part inhabited before the changes I have indicated began–and it is more probable that they were than that they were not–what a wonderfully efficient "Emigration Board" must have been at work all over the world long before canoes, or even rafts, were invented; and before men were impelled to wander by any desire nobler or stronger than hunger. And as these rude and primitive families were thrust, in the course of long series of generations, from land to land, impelled by encroachments of sea or of marsh, or by severity of summer heat or winter cold, to change their positions, what opportunities must have been offered for the play of natural selection, in preserving one family variation and destroying another!

Suppose, for example, that some families of a horde which had reached a land charged with the seeds of yellow fever, varied in the direction of woolliness of hair and darkness of skin. Then, if it be true that these physical characters are accompanied by comparative or absolute exemptions from that scourge, the inevitable tendency would be to the preservation and multiplication of the darker and woollier families, and the elimination of the whiter and smoother haired. In fact, by the operation of causes precisely similar to those which, in the famous instance cited by Mr. Darwin, have given rise to a race of black pigs in [252] the forests of Louisiana, a negro stock would eventually people the region.[18] Again, how often, by such physical changes, must a stock have been isolated from all others for innumerable

generations, and have found ample time for the hereditary hardening of its special peculiarities into the enduring characters of a persistent modification.

Nor, if it be true that the physiological differences of species may be produced by variation and natural selection, as Mr. Darwin supposes, would it be at all astonishing, if, in some of these separated stocks, the process of differentiation should have gone so far as to give rise to the phenomena of hybridity. In the face of the overwhelming evidence in favour of the unity of the origin of mankind afforded by anatomical considerations, satisfactory proof of the existence of any degree of sterility in the unions of members of two of the "persistent modifications" of mankind, might well be appealed to by Mr. Darwin as crucial evidence of the truth of his views regarding the origin of species in general.

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[1] August Schleicher. *Ueber die Bedeutung der Sprache für die Naturgeschichte des Menschen*, pp. 16-18. Weimar, 1858.

[2] Desmoulins, *Histoire Naturelle des Races Humaines*, p. 345, 1826.

[3] Latham, *Man and his Migrations*, p.171.

[4] [At cape York we found that the natives had learned from their Papuan neighbours to grow a little coarse tobacco; and elsewhere, yams are said to be grown, but hardly cultivated. Plaiting, basket-making, and netting are practiced–1894.]

[5] [With the exception of copper and bronze.–1894.]

[6] [A suspicion subsequently verified. See a memoir on American Skulls, *Journal of Anatomy and Physiology*. Vol. 16.–1894.]

[7] [The obliquity it must be recollected, is not in the position of the eyeball but arises from the arrangement of the skin in the neighbourhood of the eyelids–1894.]

[8] [See the Essay on the Aryan Question, in this volume, for some qualifications of these statements necessitated by further knowledge. 1894.]

[9] [Of the affinities of these stocks I think there can be no doubt. I was formerly inclined to believe that the ancient Egyptian was the highest term in an ascending series: Australian–Dravidian–Egyptian of allied stocks. And I believe still that there is a good deal to be said for that hypothesis. One of the most interesting problems at present is the relation of the pre-semitic population of Babylonia to the Dravidians, on the one hand, and the Old Egyptian on the other. Only one point appears to me to be quite clear, if the statues of Tell Loh represent these people, that there is not a trace of Mongolian affinity about them.–1894.]

[10] Skulls, the transverse diameter of which is more than eight-tenths the long diameter, are short; those which have the transverse diameter less than eight-tenths the longitudinal, are long.

[11] [Hindostan excepted.–1894]

[12] [Egypt excepted.–1894]

[13] [We may now safely say thirty or forty.–1894]

[14] [Supposed to be small-handed from the small handles of their bronze swords. But I observe in the Assyrian sculptures the same small handles, while the hands are by no means small. How did the Assyrians use their swords? So far as I know thrusting alone is represented.–1894.]

[15] [Later investigations tend to show that only a small part of the Sahara has been submerged.–1894.]

[16] [With reference to certain reclamations that have been made *a propos* of a speculation set forth in the essay on the *Aryan Question* (*infra*), I draw attention to the fact that this passage was written twenty-nine years ago.–1894.]

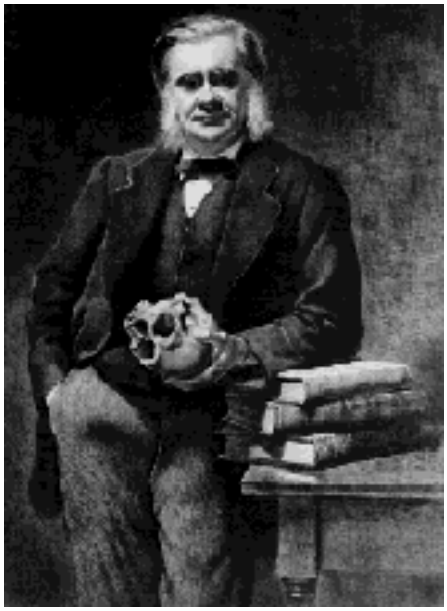
[17] [The occurrence of this extensive subsidence is disputed.–1894.]

[18] [Mr. Pearson, in his very interesting work *On National Life and Character*, justly dwells upon the obstacles to the existence of the white races within the Tropics. There is, however, this point to be considered, that the fevers to which the white men succumb are probably caused by microbes; and that modern therapeutic science is daily teaching us more and more about the ways of obtaining immunity from or alleviating these attacks. What would become of black competition if fever "vaccination" proved effectual?–1894.]

"Waitcha"

Cape York Woman with Baby

Huxley Archives



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On Some Fixed Points in British Ethnology (1871)

Collected Essays VII

[253] IN view of the many discussions to which the complicated problems offered by the ethnology of the British Islands have given rise, it may be useful to attempt to pick out, from amidst the confused masses of assertion and of inference, those propositions which appear to rest upon a secure foundation, and to state the evidence by which they are supported. Such is the purpose of the present paper.

Some of these well-based propositions relate to the physical characters of the people of Britain and their neighbours; while others concern the languages which they spoke. I shall deal, in the first place, with the physical questions.

I. *Eighteen hundred years ago the population of Britain comprised people of two types of complexion* [254] *–the one fair, and the other dark. The dark people resembled the Aquitani and the Iberians; the fair people were like the Belgic Gauls.*

The chief direct evidence of the truth of this proposition is the well-known passage of Tacitus:–

"Ceterum Britanniam qui mortales initio coluerint, indigenæ an advecti, ut inter barbaros, parum compertum. Habitus corporum varii: atque ex eo argumenta: namque rutilæ Caledoniam habitantium comæ, magni artus, Germanicam originem asseverant. Silurum colorati vultus et torti plerumque crines, et posita contra Hispania, Iberos veteres trajecisse, easque sedes occupasse, fidem faciunt. Proximi Gallis et similes sunt; seu durante originis vi, seu procurrentibus in diversa terris, positio cœli corporibus habitum dedit. In universum tamen æstimanti, Gallos vicinum solum occupasse, credibile est; eorum sacra deprehendas,superstitionum persuasione; sermo haud multum diversus." [1]

This passage, it will be observed, contains statements as to facts, and certain conclusions deduced from these facts. The matters of fact asserted are: firstly, that the inhabitants of Britain exhibit much diversity in their physical characters; secondly, that the Caledonians are red-haired and large-limbed, like the Germans; thirdly, that the Silures have curly hair and dark complexions, like the people of Spain; fourthly, that the British people nearest Gaul resemble the "Galli."

Tactitus, therefore, states positively what the Caledonians and Silures were like; but the [255] interpretation of what he says about the other Britons must depend upon what we learn from other sources as to the characters of these "Galli." Here the testimony of "divus Julius" comes in with great force and appropriateness. Cæsar writes:–

"Britanniæ pars interior ab iis incolitur, quos natos in insula ipsi memoria proditum dicunt: marituma pars ab iis, qui prædæ ac belli inferendi causa ex Belgio transierant; qui omnes fere iis nominibus civitatum appellantur quibus orti ex civitatibus eo pervenerunt, et bello inlato ibi permanserunt atque agros colere cœperunt."[2]

From these passages it is obvious that, in the opinion of Cæsar and Tacitus, the southern Britons resembled the northern Gauls, and especially the Belgæ; and the evidence of Strabo is decisive as to the characters in which the two people resembled one another: "The men [of Britain] are taller than the Kelts, with hair less yellow; they are slighter in their persons."[3]

The evidence adduced appears to leave no reasonable ground for doubting that, at the time of the Roman conquest, Britain contained people of two types, the one dark and the other fair complexioned, and that there was a certain difference between the latter in the north and in the south of Britain: the northern folk being, in the judg[256]ment of Tacitus, or, more properly, according to the information he had received from Agricola and others, more similar to the Germans than the latter. As to the distribution of these stocks, all that is clear is, that the dark people were predominant in certain parts of the west of the southern half of Britain, while the fair stock appears to have furnished the chief elements of the population elsewhere.

No ancient writer troubled himself with measuring skulls, and therefore there is no direct evidence as to the cranial characters of the fair and the dark stocks. The indirect evidence is not very satisfactory. The tumuli of Britain of pre-Roman date have yielded two extremely different forms of skull, the one broad and the other long; and the same variety has been observed in the skulls of the ancient Gauls.[4] The suggestion is obvious that the one form of skull may have been associated with the fair and the other with the dark, complexion. But any conclusion of this kind is at once checked by the reflection that the extremes of long and short-headedness are to be met with among the fair inhabitants of Germany and of Scandinavia at the present day–the southwestern Germans and the Swiss being markedly broad-headed, while the Scandinavians are as predominantly long-headed.

[257] What the natives of Ireland were like at the time of the Roman conquest of Britain, and for centuries afterwards, we have no certain knowledge; but the earliest trustworthy records prove the existence, side by side with one another, of a fair and a dark stock, in Ireland as in Britain. The long form of skull is predominant among the ancient, as among modern, Irish.

II. *The people termed Gauls, and those called Germans, by the Romans, did not differ in any important physical character.*

The terms in which the ancient writers describe both Gauls and Germans are identical. They are always tall people, with massive limbs, fair skins, fierce blue eyes, and hair the colour of which ranges from red to yellow. Zeuss, the great authority on these matters, affirms broadly that no distinction in bodily feature is to be found between the Gauls, the Germans, and the Wends, so far as their characters are recorded by the old historians; and he proves his case by citations from a cloud of witnesses.

An attempt has been made to show that the colour of the hair of the Gauls must have differed very much from that which obtained among the Germans, on the strength of the story told by Suetonius (*Caligula*, 4), that Caligula tried to pass off Gauls for Germans by picking out the tallest, and making then "rutilare

et summittere comam."

[258] The Baron de Belloguet remarks upon this passage:

"It was in the very north of Gaul, and near the sea, that Caligula got up this military comedy. And the fact proves that the Belgian were already sensibly different from their ancestors, whom Strabo had found almost identical with their *brothers* on the other side of the Rhine."

But the fact recorded by Suetonius, if fact it be, proves nothing; for the Germans themselves were in the habit of reddening their hair. Ammianus Marcellinus[5] tells how, in the year 367 A.D., the Roman commander, Jovinus, surprised a body of Alemanni near the town now called Charpeigne, in the valley of the Moselle; and how the Roman soldiers, as, concealed by the thick wood, they stole upon their unsuspecting enemies, saw that some were bathing and others "comas rutilantes ex more." More than two centuries earlier Pliny gives indirect evidence to the same effect when he says of soap:–

"Gilliarum hoc inventum rutilandis capillis . . . apud Germanos majore in usu viris quam fœminis."[6]

Here we have a writer who flourished not very long after the date of the Caligula story, telling us that the Gauls invented soap for the purpose of doing that which, according to Suetonius, Caligula forced them to do. And, further [259] the combined and independent testimony of Pliny and Ammianus assures us that the Germans were as much in the habit of reddening their hair as the Gauls. As to De Belloguet's supposition that, even in Caligula's time, the Gauls had become darker than their ancestors were, it is directly contradicted by Ammianus Marcellinus, who knew the Gauls well."Celsioris staturæ et candidi pœne Galli sunt omnes, et rutili, luminumque torvitate terribiles," is his description; and it would fit the Gauls who sacked Rome.

III. *In none of the invasions of Britain which have taken place since the Roman dominion, has any other type of man been introduced than one or other of the two which existed during that dominion.*

The North Germans, who effected what is commonly called the Saxon conquest of Britain, were, most assuredly, a fair, yellow, or red-haired, blue-eyed, long-skulled people. So were the Danes and the Norsemen who followed them; though it is very possible that the active slave trade which went on, and the intercourse with Ireland, may have introduced a certain admixture of the dark stock into both Denmark and Norway. The Norman conquest brought in new ethnological elements, the precise value of which cannot be estimated with exactness; but as to their quality, there can be no question, inasmuch as even the wide area from which William drew his followers could yield him nothing but the fair and the dark [260] types of men, already present in Britain. But whether the Norman settlers, on the whole, strengthened the fair or the dark element, is a problem, the elements of the solution of which are not attainable.

I am unable to discover any grounds for believing that a Lapp element has ever entered into the population of these islands. So far as the physical evidence goes, it is perfectly consistent with the

hypothesis that the only constituent stocks of that population, now, or at any other period about which we have evidence, are the dark whites, whom I have proposed to call "*Melanochroi*," and the fair whites, or *"Xanthochroi.*"

IV. *The Xanthochroi and the Melanochroi of Britain are, speaking broadly, distributed, at present, as they were in the time of Tacitus; and their representatives on the continent of Europe have the same general distribution as at the earliest period of which we have any record.*

At the present day, and notwithstanding the extensive intermixture effected by the movements consequent on civilization and on political changes, there is a predominance of dark men in the west, and of fair men in the east and north, of Britain. At the present day, as from the earliest times, the predominant constituents of the riverain population of the North Sea and the eastern half of the British Channel, are fair men. The fair stock continues in force through Central Europe, until [261] it is lost in Central Asia. Offshoots of this stock extend into Spain, Italy, and Northern India, and by way of Syria and North Africa, to the Canary Islands. They were known in very early times to the Chinese, and in still earlier to the ancient Egyptians, as frontier tribes. The Thracians were notorious for their fair hair and blue eyes many centuries before our era.

On the other hand, the dark stock predominates in Southern and Western France, in Spain, along the Ligurian shore, and in Western and Southern Italy; in Greece, Asia, Syria, and North Africa; in Arabia, Persia, Afghanistan, and Hindostan, shading gradually, through all stages of darkening, into the type of the modern Egyptian, or of the wild Hill-man of the Dekkan. Nor is there any record of the existence of a different population in all these countries.

The extreme north of Europe, and the northern part of Western Asia, are at present occupied by a Mongoloid stock, and, in the absence of evidence to the contrary, may be assumed to have been so peopled from a very remote epoch. But, as I have said, I can find no evidence that this stock ever took part in peopling Britain. Of the three great stocks of mankind which extend from the western coast of the great Eurasiatic continent to its southern and eastern shores, the Mongoloids occupy a vast triangle, the base of which is the whole of Eastern Asia, while its apex lies in [262] Lapland. The Melanochroi, on the other hand, may be represented as a broad band stretching from Ireland to Hindostan; while the Xanthochroic area lies between the two, thins out, so to speak, at either end, and mingles, at its margins, with both its neighbours.

Such is a brief and summary statement of what I believe to be the chief facts relating to the physical ethnology of the people of Britain. The conclusions which I draw from these and other facts are–(1) That the Melanochroi and the Xanthochroi are two separate races in the biological sense of the word race; (2) That they have had the same general distribution as at present from the earliest times of which any record exists on the continent of Europe; (3) That the population of the British Islands is derived from them, and from them only.

The people of Europe, however, owe their national names, not to their physical characteristics, but to

their languages, or to their political relations; which, it is plain, need not have the slightest relation to these characteristics.

Thus, it is quite certain that, in Cæsar's time, Gaul was divided political]y into three nationalities–the Belgæ, the Celtæ, and the Aquitani; and that the last were very widely different, both in language and in physical characteristics, from the two former. The Belgæ and the Celtæ, on the other hand, differed comparatively little either [263] in physique or in language. On the former point there is the distinct testimony of Strabo; as to the latter, St. Jerome states that the "Galatians had almost the same language as the Treviri." Now, the Galatians were emigrant Volcæ Tectosages, and therefore Celtæ; while the Treviri were Belgæ.[7]

At the present day, the physical characters of the people of Belgic Gaul remain distinct from those of the people of Aquitaine, notwithstanding the immense changes which have taken place since Cæsar's time; but Belgæ, Celtæ, and Aquitani (all but a mere fraction of the last two, represented by the Basques and the Bretons) are fused into one nationality, "le peuple Français." But they have adopted the language of one set of invaders, and the name of another; their original names and languages having almost disappeared. Suppose that the French language remained as the sole evidence of the existence of the population of Gaul, would the keenest philologer arrive at any other conclusion than that this population was essentially and fundamentally a "Latin" race, which had had some communication with Celts and Teutons? Would he so much as suspect the former existence of the Aquitani?

Community of language testifies to close contact between the people who speak the language, but to nothing else; philology has absolutely nothing to do with ethnology, except so far as it suggests [264] the existence or the absence of such contact. The contrary assumption, that language is a test of race, has introduced the utmost confusion into ethnological speculation, and has nowhere worked greater scientific and practical mischief than in the ethnology of the British Islands.

What is known, for certain, about the languages spoken in these islands and their affinities may, I believe, be summed up as follows:–

I. *At the time of the Roman conquest, one language, the Celtic, under two principal dialectical divisions, the Cymric and the Gaelic, was spoken throughout the British Islands. Cymric was spoken in Britain, Gaelic*[8] *in Ireland.*

If a language allied to Basque had in earlier times been spoken in the British Islands, there is no evidence that any Euskarian-speaking people remained at the time of the Roman conquest. The dark and the fair population of Britain alike spoke Celtic tongues, and therefore the name "Celt" is as applicable to the one as to the other.

What was spoken in Ireland can only be surmised by reasoning from the knowledge of later times; but there seems to be no doubt that it was Gaelic.

[265] II. *The Belgæ and the Celtic, with the offshoots of the latter in Asia Minor, spoke dialects of the Cymric division of Celtic.*

The evidence of this proposition lies in the statement of St. Jerome before cited; in the similarity of the names of places in Belgic Gaul and in Britain; and in the direct comparison of sundry ancient Gaulish and Belgic words which have been preserved, with the existing Cymric dialects, for which I must refer to the learned work of Brandes.

Formerly, as at the present day, the Cymric dialects of Celtic were spoken by both the fair and the dark stocks.

III. *There is no record of Gaelic being spoken anywhere save in Ireland, Scotland, and the Isle of Man.*

This appears to be the final result of the long discussions which have taken place on this much-debated question. As is the case with the Cymric dialects, Gaelic is now spoken by both dark and fair stocks.

IV. *When the Teutonic languages first became known, they were spoken only*[9] *by Xanthochroi, that is to say, by the Germans, the Scandinavians, and Goths. And they were imported by Xanthochroi into Gaul and into Britain.*

In Gaul, the imported Teutonic dialect has been [266] completely overpowered by the more or less modified Latin, which it found already in possession; and what Teutonic blood there may be in modern Frenchmen is not adequately represented in their language. In Britain, on the contrary the Teutonic dialects have overpowered the pre-existing forms of speech, and the people are vastly less "Teutonic" than their language. Whatever may have been the extent to which the Celtic-speaking population of the eastern half of Britain was trodden out and supplanted by the Teutonic-speaking Saxons and Danes, it is quite certain that no considerable displacement of the Celtic-speaking people occurred in Cornwall, Wales, or the Highlands of Scotland; and that nothing approaching to the extinction of that people took place in Devonshire, Somerset, or the western moiety of Britain generally. Nevertheless, the fundamentally Teutonic English language is now spoken throughout Britain, except by an insignificant fraction of the population in Wales and the Western Highlands. But it is obvious that this fact affords not the slightest justification for the common practice of speaking of the present inhabitants of Britain as an "Anglo-Saxon" race. It is, in fact, just as absurd as the habit of talking of the French people as a "Latin" race, because they speak a language which is, in the main, derived from Latin. And the absurdity becomes the more patent when those who have no hesita[267]tion in calling a Devonshire man, or a Cornish man, an "Anglo-Saxon," would think it ridiculous to call a Tipperary man by the same title, though he and his forefathers may have spoken English for as long a time as the Cornish man.

Ireland, at the earliest period of which we have any knowledge, contained, like Britain, a dark and a fair stock, which, there is every reason to believe, were identical with the dark and the fair stocks of Britain. When the Irish first became known they spoke a Gaelic dialect, and though, for many centuries, Scandinavians made continual incursions upon, and settlements among them, the Teutonic languages

made no more way among the Irish than they did among the French. How much Scandinavian blood was introduced there is no evidence to show. But after the conquest of Ireland by Henry II., the English people, consisting in part of the descendants of Cymric speakers, and in part of the descendants of Teutonic speakers, made good their footing in the eastern half of the island, as the Saxons and Danes made good theirs in England; and did their best to complete the parallel by attempting the extirpation of the Gaelic-speaking Irish. And they succeeded to a considerable extent; a large part of Eastern Ireland is now peopled by men who are substantially English by descent, and the English language has spread over the land far beyond the limits of English blood.

[268] Ethnologically, the Irish people were originally, like the people of Britain, a mixture of Melanochroi and Xanthochroi. They resembled the Britons in speaking a Celtic tongue; but it was a Gaelic and not a Cymric form of the Celtic language. Ireland was untouched by the Roman conquest, nor do the Saxons seem to have had any influence upon her destinies, but the Danes and Norsemen poured in a contingent of Teutonism, which has been largely supplemented by English and Scotch efforts.

What, then, is the value of the ethnological difference between the Englishman of the western half of England and the Irishman of the eastern half of Ireland? For what reason does the one deserve the name of a "Celt," and not the other? And further, if we turn to the inhabitants of the western half of Ireland, why should the term "Celts" be applied to them more than to the inhabitants of Cornwall? And if the name is applicable to the one as justly as to the other, why should not intelligence, perseverance, thrift, industry, sobriety, respect for law, be admitted to be Celtic virtues? And why should we not seek for the cause of their absence in something else than the idle pretext of "Celtic blood"?

I have been unable to meet with any answers to these questions.

V. *The Celtic and the Teutonic dialects are members of the same great Aryan family of lan*[269]*guages; but there is evidence to show that a non-Aryan language was at one time spoken over a large extent of the area occupied by Melanochroi in Europe.*

The non-Aryan language here referred to is the Euskarian, now spoken only by the Basques, but which seems in earlier times to have been the language of the Aquitanians and Spaniards, and may possibly have extended much further to the East. Whether it has any connection with the Ligurian and Oscan dialects are questions upon which, of course, I do not presume to offer any opinion. But it is important to remark that it is a language the area of which has gradually diminished without any corresponding extirpation of the people who primitively spoke it; so that the people of Spain and of Aquitaine at the present day must be largely "Euskarian" by descent in just the same sense as the Cornish men are "Celtic" by descent.

Such seem to me to be the main facts respecting the ethnology of the British islands and of Western Europe, which may be said to be fairly established. The hypothesis by which I think (with De Belloguet and Thurman) the facts may best be explained is this: In very remote times Western Europe and the

British islands were inhabited by the dark stock, or the Melanochroi, alone, and these Melanochroi spoke dialects allied to the Euskarian. The Xanthochroi, spreading [270] over the great Eurasiatic plains westward, and speaking Aryan dialects, gradually invaded the territories of the Melanochroi. The Xanthochroi, who thus came into contact with the Western Melanochroi, spoke a Celtic language; and that Celtic language, whether Cymric or Gaelic, spread over the Melanochroi far beyond the limits of intermixture of blood, supplanting Euskarian, just as English and French have supplanted Celtic. Even as early as Cæsar's time, I suppose that the Euskarian was everywhere, except in Spain and in Aquitaine, replaced by Celtic, and thus the Celtic speakers were no longer of one ethnological stock, but of two. Both in Western Europe and in England a third wave of language–in the one case Latin, in the other Teutonic–has spread over the same area. In Western Europe, it has left a fragment of the primary Euskarian in one corner of the country, and a fragment of the secondary Celtic in another. In the British islands, only outlying pools of the secondary linguistic wave remain in Wales, the Highlands, Ireland, and the Isle of Man. If this hypothesis is a sound one, it follows that the name of Celtic is not properly applicable to the Melanochroic or dark stock of Europe. They are merely, so to speak, secondary Celts. The primary and aboriginal Celtic-speaking people are Xanthochroi–the typical Gauls of the ancient writers, and the close allies by blood, customs, and language, of the Germans.

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[1] Tacitus *Agricola*, c. 11.

[2] *De Bello Gallico*, v. 12.

[3] The Geography of Strabo. Translated by Hamilton and Falconer, v. 5.

[4] See Dr. Thurnam "On the Two principal Forms of Ancient British and Gaulish Skulls."

[5] *Res Gestæ*, xxvii.

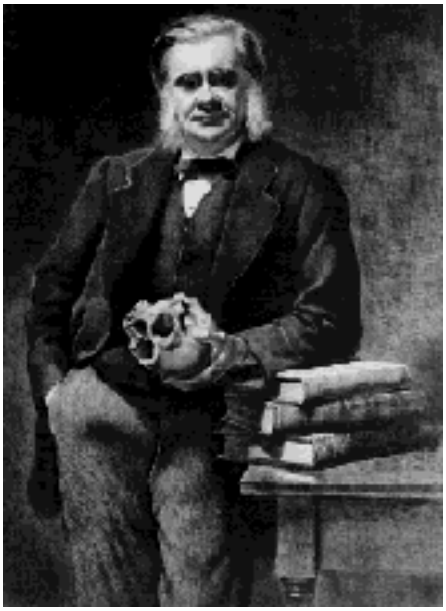
[6] *Historia Naturalis*, xxviii. 51.

[7] [This proposition is disputed.–1894.]

[8] [I have been told that the terms "Cymric" and "Gaelic" are antiquated and improper. The reader will please substitute Celtic dialect A and Celtic dialect B for them, and consult, on this subject, especially with regard to proposition III., Professor Rhys' *Early Britain*.–1894.]

[9] ["Only" is too strong a word, as there were doubtless some Melanochroi among the Teutonic tribes.–1894.]

THE HUXLEY FILE



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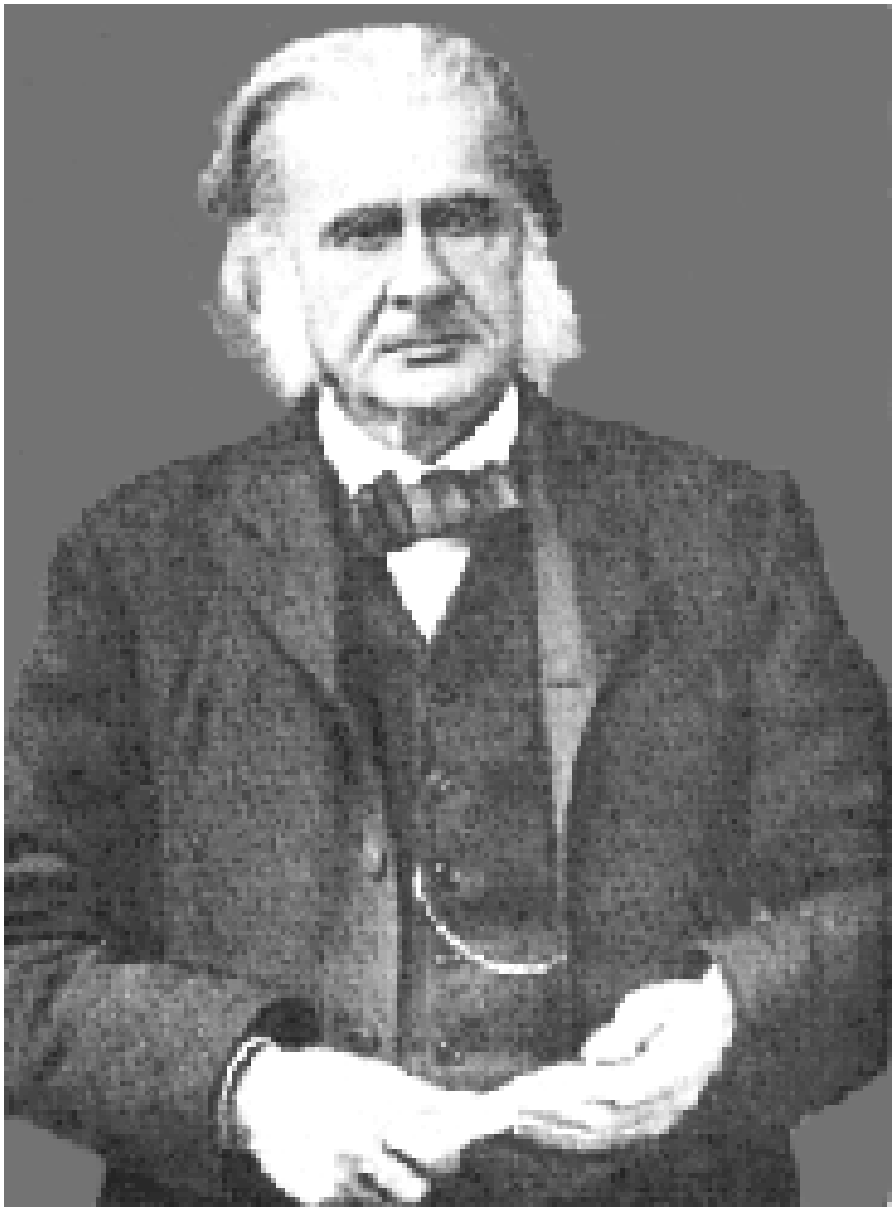

Aryan T. H. H.

Photograph by Downey 1890

L. Huxley, *Life and Letters*

The Aryan Question and Pre-Historic Man (1890)

Collected Essays VII

[271] The rapid increase of natural knowledge, which is the chief characteristic of our age, is effected in various ways. The main army of science moves to the conquest of new worlds slowly and surely, nor

ever cedes an inch of the territory gained. But the advance is covered and facilitated by the ceaseless activity of clouds of light troops provided with a weapon–always efficient, if not always an arm of precision–the scientific imagination. It is the business of these *enfants perdus* of science to make raids into the realm of ignorance wherever they see, or think they see, a chance; and cheerfully to accept defeat, or it may be annihilation, as the reward of error. Unfortunately, the public, which watches the progress of the campaign, too often mistakes a dashing incursion of the Uhlans for a forward movement of the main [272] body; fondly imagining that the strategic movement to the rear, which occasionally follows, indicates a battle lost by science. And it must be confessed that the error is too often justified by the effects of the irrepressible tendency which men of science share with all other sorts of men known to me, to be impatient of that most wholesome state of mind–suspended judgment; to assume the objective truth of speculations which from the nature of the evidence in their favour, can have no claim to be more than working hypotheses.

The history of the "Aryan question" affords a striking illustration of these general remarks.

About a century ago, Sir William Jones pointed out the close alliance of the chief European languages with Sanskrit and its derivative dialects now spoken in India. Brilliant and laborious philologists, in long succession, enlarged and strengthened this position, until the truth that Sanskrit, Zend, Armenian, Greek, Latin, Lithuanian, Slavonian, German, Celtic, and so on, stand to one another in the relation of descendants from a common stock, became firmly established, and thenceforward formed part of the permanent acquisitions of science. Moreover, the term "Aryan" is very generally, if not universally, accepted as a name for the group of languages thus allied. Hence, when one speaks of "Aryan languages," no hypothetical assumptions are in[273]volved. It is a matter of fact that such languages exist, that they present certain substantial and formal relations, and that convention sanctions the name applied to them. But the close connection of these widely differentiated languages remains altogether inexplicable, unless it is admitted that they are modifications of an original relatively undifferentiated tongue; just as the intimate affinities of the Romance languages–French, Italian, Spanish, and the rest–would be incomprehensible if there were no Latin. The original or "primitive Aryan" tongue, thus postulated, unfortunately no longer exists. It is a hypothetical entity, which corresponds with the "primitive stock" of generic and higher groups among plants and animals; and the acknowledgment of its former existence, and of the process of evolution which has brought about the present state of things philological, is forced upon us by deductive reasoning of similar cogency to that employed about things biological.

Thus, the former existence of a body of relatively uniform dialects, which may be called primitive Aryan, may be added to the stock of definitely acquired truths. But it is obvious that, in the absence of writing or of phonographs, the existence of a language implies that of speakers. If there were primitive Aryan dialects, there must have been primitive Aryan people who used them; and these people must have resided [274] somewhere or other on the earth's surface. Hence philology, without stepping beyond its legitimate bounds and keeping speculation within the limits of bare necessity, arrives, not only at the conceptions of Aryan languages and of a primitive Aryan language; but of a primitive Aryan people and of a primitive Aryan home, or country occupied by them.

But where was this home of the Aryans? When the labours of modern philologists began, Sanskrit was the most archaic of all the Aryan languages known to them. It appeared to present the qualifications required in the parental or primitive Aryan. Brilliant Uhlans made a charge at this opening. The scientific imagination seated the primitive Aryans in the valley of the Ganges; and showed, as in a vision, the successive columns, guided by enterprising Brahmins, which set out thence to people the regions of the western world with Greeks and Celts and Germans. But the progress of philology itself sufficed to show that this Balaclava charge, however magnificent, was not profitable warfare. The internal evidence of the Vedas proved that their composers had not reached the Ganges. On the other hand, the comparison of Zend with Sanskrit left no alternative open to the assumption that these languages were modifications of an original Indo-Iranian tongue, spoken by a people of whom the Aryans of India and those of Persia were offshoots, [275] and who could therefore be hardly lodged elsewhere than on the frontiers of both Persia and India–that is to say, somewhere in the region which is at present known under the names of Turkestan, Afghanistan, and Kafiristan. Thus far, it can hardly be doubted that we are well within the ground of which science has taken enduring possession. But the Uhlans were not content to remain within the lines of this surely-won position. For some reason, which is not quite clear to me, they thought fit to restrict the home of the primitive Aryans to a particular part of the region in question; to lodge them amidst the bleak heights of the long range of the Hindoo Koosh and on the inhospitable plateau of Pamir. From their hives in these secluded valleys and windswept wastes, successive swarms of Celts and Greco-Latins, Teutons and Slavs, were thrown off to settle, after long wanderings, in distant Europe. The Hindoo-Koosh-Pamir theory, once enunciated, gradually hardened into a sort of dogma; and there have not been wanting theorists, who laid down the routes of the successive bands of emigrants with as much confidence as if they had access to the records of the office of a primitive Aryan Quartermaster-General. It is really singular to observe the deference which has been shown, and is yet sometimes shown, to a speculation which can, at best, claim to be regarded as nothing better than a somewhat risky working hypothesis.

[276] Forty years ago, the credit of the Hindoo-Koosh-Pamir theory had risen almost to that of an axiom. The first person to instil doubt of its value into my mind was the late Robert Gordon Latham, a man of great learning and singular originality, whose attacks upon the Hindoo-Kooshite doctrine could scarcely have failed as completely as they did, if his great powers had been bestowed upon making his books not only worthy of being read, but readable. The impression left upon my mind, at that time, by various conversations about the "Sarmatian hypothesis," which my friend wished to substitute for the Hindoo-Koosh-Pamir speculation, was that the one and the other rested pretty much upon a like foundation of guesswork. That there was no sufficient reason for planting the primitive Aryans in the Hindoo Koosh, or in Pamir, seemed plain enough; but that there was little better ground, on the evidence then adduced, for settling them in the region at present occupied by Western Russia, or Podolia, appeared to me to be not less plain. The most I thought Latham proved was, that the Aryan people of Indo-Iranian speech were just as likely to have come from Europe, as the Aryan people of Greek, or Teutonic, or Celtic speech from Asia. Of late years, Latham's views, so long neglected, or mentioned merely as an example of insular eccentricity, have been taken up and advocated with much ability in Germany [277] as well as in this country–principally by philologists. Indeed, the glory of Hindoo-Koosh-Pamir seems altogether to have departed. Professor Max Müller, to whom Aryan philology owes so much, will not say more now, than that he holds by the conviction that the seat of the primitive Aryans was "somewhere in Asia."

Dr. Schrader sums up in favour of European Russia; while Herr Penka would have us transplant the home of the primitive Aryans from Pamir in the far east to the Scandinavian peninsula in the far west.

I must refer those who desire to acquaint themselves with the philological arguments on which these conclusions are based to the recently published works of Dr. Schrader and Canon Taylor;[1] and to Penka's "Die Herkunft der Arier," which, in spite of the strong spice of the Uhlan which runs through it, I have found extremely well worth study. I do not pretend to be able to look at the Aryan question under any but the biological aspect; to which I now turn.

Any biologist who studies the history of the Aryan question, and, taking the philological facts on trust, regards it exclusively from the point of view of anthropology, will observe that, very early, the purely biological conception of "race" [278] illegitimately mixed itself up with the ideas derived from pure philology. It is quite proper to speak of Aryan "people," because, as we have seen, the existence of the language implies that of a people who speak it; it might be equally permissible to call Latin people all those who speak Romance dialects. But, just as the application of the term Latin "race" to the divers people who speak Romance languages, at the present day, is none the less absurd because it is common; so, it is quite possible, that it may be equally wrong to call the people who spoke the primitive Aryan dialects and inhabited the primitive home, the Aryan race. "Aryan" is properly a term of classification used in philology. "Race" is the name of a sub-division of one of those groups of living things which are called "species" in the technical language of Zoology and Botany; and the term connotes the possession of characters distinct from those of the other members of the species, which have a strong tendency to appear in the progeny of all members of the races. Such race-characters may be either bodily or mental, though in practice, the latter, as less easy of observation and definition, can rarely be taken into account. Language is rooted half in the bodily and half in the mental nature of man. The vocal sounds which form the raw materials of language could not be produced without a peculiar conformation of the organs of speech; the enuncia[279]tion of duly accented syllables would be impossible without the nicest co-ordination of the action of the muscles which move these organs; and such co-ordination depends on the mechanism of certain portions of the nervous system. It is therefore conceivable that the structure of this highly complex speaking apparatus should determine a man's linguistic potentiality; that is to say, should enable him to use a language of one class and not of another. It is further conceivable that a particular linguistic potentiality should be inherited and become as good a race mark as any other. As a matter of fact, it is not proven that the linguistic potentialities of all men are the same. It is affirmed, for example, that, in the United States, the enunciation and the timbre of the voice of an American-born negro, however thoroughly he may have learned English, can be readily distinguished from that of a white man. But, even admitting that differences may obtain among the various races of men, to this extent, I do not think that there is any good ground for the supposition that an infant of any race would be unable to learn, and to use with ease, the language of any other race of men among whom it might be brought up. History abundantly proves the transmission of languages from some races to others; and there is no evidence, that I know of, to show that any race is incapable of substituting a foreign idiom for its native tongue.

From these considerations it follows that com[280]munity of language is no proof of unity of race, is not

even presumptive evidence of racial identity.[2] All that it does prove is that, at some time or other, free and prolonged intercourse has taken place between the speakers of the same language. Philology, therefore, while it may have a perfect light to postulate the existence of a primitive Aryan "people," has no business to substitute "race" for "people." The speakers of primitive Aryan may have been a mixture of two or more races, just as are the speakers of English and of French, at the present time.

The older philological ethnologists felt the difficulty which arose out of their identification of linguistic with racial affinity, but were not dismayed by it. Strong in the prestige of their great discovery of the unity of the Aryan tongues, they were quite prepared to make the philological and the biological categories fit, by the exercise of a little pressure on that about which they knew less. And their judgment was often un[281]consciously warped by strong monogenistic proclivities, which, at bottom, however respectable and philanthropic their origin, had nothing to do with science. So the patent fact that men of Aryan speech presented widely diverse racial characters was explained away by maintaining that the physical differentiation was post-Aryan; to put it broadly, that the Aryans in Hindoo-Koosh-Pamir were truly of one race; but that, while one colony, subjected to the sweltering heat of the Gangetic plains, had fined down and darkened into the Bengalee, another had bleached and shot up, under the cool and misty skies of the north, into the semblance of Pomeranian Grenadiers; or of blue-eyed, fair-skinned, six-foot Scotch Highlanders. I do not know that any of the Uhlans who fought so vigorously under this flag are left now. I doubt if any one is prepared to say that he believes that the influence of external conditions, alone, accounts for the wide physical differences between Englishmen and Bengalese. So far as India is concerned, the internal evidence of the old literature sufficiently proves that the Aryan invaders were "white" men. It is hardly to be doubted that they intermixed with the dark Dravidian aborigines; and that the high-caste Hindoos are what they are in virtue of the Aryan blood which they have inherited,[3] and of [282] the selective influence of their surroundings operating on the mixture.

The assumption that, as there must have been a primitive Aryan people, in the philological sense, so that people must have constituted a race in the biological sense, is pretty generally made in modern discussions of the Aryan problem. But whether the men of the primitive Aryan race were blonds or brunets, whether they had long or round heads, were tall or were short, are hotly debated questions, into the discussion of which considerations quite foreign to science are sometimes imported. The combination of swarthiness with stature above the average and a long skull, confer upon me the serene impartiality of a mongrel; and, having given this pledge of fair dealing, I proceed to state the case for the hypothesis I am inclined to adopt. In doing so, I am aware that I deliberately take the shilling of the recruiting sergeant of the Light Brigade, and I warn all and sundry that such is the case.

Looking at the discussions which have taken [283] place from a purely anthropological point of view, the first point which has struck me is that the problem is far more complicated and difficult than many of the disputants appear to imagine; and the second, that the data upon which we have to go are grievously insufficient in extent and in precision. Our historical records cover such an infinitesimally small extent of the past life of humanity, that we obtain little help from them. Even so late as 1500 B.C., northern Eurasia lies in historical darkness, except for such glimmer of light as may be thrown here and there by the literatures of Egypt and of Babylonia. Yet, at that time, it is probable that Sanskrit, Zend, and Greek,

to say nothing of other Aryan tongues, had long been differentiated from primitive Aryan. Even a thousand years later, little enough accurate information is to be had about the racial characters of the European and Asiatic tribes known to the Greeks. We are thrown upon such resources as archæology and human palæontology have to offer, and notwithstanding the remarkable progress made of late years, they are still meagre. Nevertheless, it strikes me that, from the purely anthropological side, there is a good deal to be said in favour of the two propositions maintained by the new school of philologists; first, that the people who spoke "primitive Aryan" were a distinct and well-marked race of mankind; and, secondly, that [284] the area of the distribution of this race, in primæval times, lay in Europe, rather than in Asia.

For the last two thousand years, at least, the southern half of Scandinavia and the opposite or southern shores of the Baltic have been occupied by a race of mankind possessed of very definite characters. Typical specimens have tall and massive frames, fair complexions, blue eyes, and yellow or reddish hair–that is to say, they are pronounced blonds. Their skulls are long, in the sense that the breadth is usually less, often much less, than four-fifths of the length, and they are usually tolerably high. But in this last respect they vary. Men of this blond, long-headed race abound from eastern Prussia to northern Belgium; they are met with in northern France and are common in some parts of our own islands. The people of Teutonic speech, Goths, Saxons, Alemanni, and Franks, who poured forth out of the regions bordering the North Sea and the Baltic, to the destruction of the Roman Empire, were men of this race; and the accounts of the ancient historians of the incursions of the Gauls into Italy and Greece, between the fifth and the second centuries B.C., leave little doubt that their hordes were largely, if not wholly, composed of similar men. The contents of numerous interments in southern Scandinavia prove that, as far back as archæology takes us into the so-called neolithic age, the great majority of the inhabitants had the [285] same stature and cranial peculiarities as at present, though their bony fabric bears marks of somewhat greater ruggedness and savagery. There is no evidence that the country was occupied by men before the advent of these tall, blond long-heads. But there is proof of the presence, along with the latter, of a small percentage of people with broad skulls; skulls, that is, the breadth of which is more, often very much more, than four-fifths of the length.

At the present day, in whatever direction we travel inland from the continental area occupied by the blond long-heads, whether south-west, into central France; south, through the Walloon provinces of Belgium into eastern France; into Switzerland, South Germany, and the Tyrol; or south-east, into Poland and Russia; or north, into Finland and Lapland, broad-heads make their appearance, in force, among the long-heads. And, eventually, we find ourselves among people who are as regularly broad-headed as the Swedes and North Germans are long-headed. As a general rule, in France, Belgium, Switzerland, and South Germany, the increase in the proportion of broad skulls is accompanied by the appearance of a larger and larger proportion of men of brunet complexion and of a lower stature; until, in central France and thence eastwards, through the Cevennes and the Alps of Dauphiny, Savoy, and Piedmont, to the western plains of North Italy, the [286] *tall blond long-heads*[4] practically disappear and are replaced by *short brunet broad-heads.* The ordinary Savoyard may be described in terms the converse of those which apply to the ordinary Swede. He is short, swarthy, dark-eyed, dark-haired, and his skull is very broad. Between the two extreme types, the one seated on the shores of the North Sea and the Baltic, and the other on those of the Mediterranean, there are all sorts of intermediate forms, in which breadth of

skull may be found in tall and in short blond men, and in tall brunet men.

There is much reason to believe that the brunet broad-heads, now met with in central France and in the west central European highlands, have inhabited the same region, not only throughout the historical period, but long before it commenced; and it is probable that their area of occupation was formerly more extensive. For, if we leave [287] aside the comparatively late incursions of the Asiatic races, the centre of eruption of the invaders of the southern moiety of Europe has been situated in the north and west. In the case of the Teutonic inroads upon the Empire of Rome, it undoubtedly lay in the area now occupied by the blond long-heads; and, in that of the antecedent Gaulish invasions, the physical characters ascribed to the leading tribes point to the same conclusion. Whatever the causes which led to the breaking out of bounds of the blond long-heads, in mass, at particular epochs, the natural increase in numbers of a vigorous and fertile race must always have impelled them to press upon their neighbours, and thereby afford abundant occasions for intermixture. If, at any given pre-historic time, we suppose the lowlands verging on the Baltic and the North Sea to have been inhabited by pure blond long-heads, while the central highlands were occupied by pure brunet short-heads, the two would certainly meet and intermix in course of time, in spite of the vast belt of dense forest which extended, almost uninterruptedly, from the Carpathians to the Ardennes; and the result would be such an irregular gradation of the one type into the other as we do, in fact, meet with.

On the south-east, east, and north-east, throughout what was once the kingdom of Poland, and in Finland the preponderance of broad-heads goes along with a wide prevalence of blond complexion [288] and of good stature. In the extreme north, on the other hand, marked broad-headedness is combined with low stature, swarthiness, and more or less strongly mongolian features, in the Lapps. And it is to be observed that this type prevails increasingly to the eastward, among the central Asiatic populations.

The population of the British Islands, at the present time, offers the two extremes of the tall blond and the short brunet types. The tall blond long-heads resemble those of the continent; but our short brunet race is long-headed. Brunet broad-heads, such as those met with in the central European highlands, do not exist among us. This absence of any considerable number of distinctly broad-headed people (say with the cephalic index above 81 or 82) in the modern population of the United Kingdom is the more remarkable, since the investigations of the late Dr. Thurnam, and others, proved the existence of a large proportion of tall broad-heads among the people interred in British tumuli of the neolithic age. It would seem that these broad-skulled immigrants have been absorbed by an older long-skulled population; just as, in South Germany, the long-headed Alemanni have been absorbed by the older broad-heads. The short brunet long-heads are not peculiar to our islands. On the contrary, they abound in western France and in Spain, while they predominate in Sardinia, Corsica, [289] and South Italy, and, it may be, occupied a much larger area in ancient times.

Thus, in the region which has been under consideration, there are evidences of the existence of four races of men–(1) blond long-heads of tall stature, (2) brunet broad-heads of short stature, (3) mongoloid brunet broad-heads of short stature, (4) brunet long-heads of short stature. The regions in which these races appear with least admixture are–(l) Scandinavia, North Germany, and parts of the British Islands;

(2) central France, the central European highlands, and Piedmont; (3) Arctic and eastern Europe, central Asia; (4) the western parts of the British Islands and of France; Spain, South Italy. And the inhabitants of the localities which lie between these foci present the intermediate gradations, such as short blond long-heads, and tall brunet short-heads and long-heads which might be expected to result from their intermixture. The evidence at present extant is consistent with the supposition that the blond long-heads, the brunet broad-heads, and the brunet long-heads have existed in Europe throughout historic times, and very far back into pre-historic times. There is no proof of any migration of Asiatics into Europe, west of the basin of the Dnieper, down to the time of Attila. On the contrary, the first great movements of the European population of which there is any conclusive evidence is that series of Gaulish invasions [290] of the east and south, which ultimately extended from North Italy as far as Galatia in Asia Minor.

It is now time to consider the relations between the phenomena of racial distribution, as thus defined, and those of the distribution of languages. The blond long-heads of Europe speak, or have spoken, Lithuanian, Teutonic, or Celtic dialects, and they are not known to have ever used any but these Aryan languages. A large proportion of the brunet broad-heads once spoke the Ligurian and the Rhætic dialects, which are believed to have been non-Aryan. But, when the Romans made acquaintance with Transalpine Gaul, the inhabitants of that country between the Garonne and the Seine (Cæsar's *Celtica*) seem, at any rate for the most part, to have spoken Celtic dialects. The brunet long-heads of Spain and of France appear to have used a non-Aryan language, that Euskarian which still lives on the shores of the Bay of Biscay. In Britain there is no certain knowledge of their use of any but Celtic tongues. What they spoke in the Mediterranean islands and in South Italy does not appear.

The blond broad-heads of Poland and West Russia form part of a people who, when they first made their appearance in history, occupied the marshy plains imperfectly drained by the Vistula, on the west, the Duna, on the north, and the Dnieper and Bug, on the south. They were [291] known to their neighbours as Wends, and among themselves as Serbs and Slavs. The Slavonic languages spoken by these people are said to be most closely allied to that of the Lithuanians, who lay upon their northern border. The Slavs resemble the South Germans in the predominance of broad-heads among them, while stature and complexion vary from the, often tall, blonds who prevail in Poland and great Russia to the, often short, brunets common elsewhere. There is certainly nothing in the history of the Slav people to interfere with the supposition that, from very early times, they have been a mixed race. For their country lies between that of the tall blond long-heads on the north, that of the short brunet broad-heads of the European type on the west, and that of the short brunet broad-heads of the Asiatic type on the east: and, throughout their history, they have either thrust themselves among their neighbours, or have been overrun and trampled down by them. Gauls and Goths have traversed their country, on their way to the east and south: Finno-tataric people, on their way to the west, have not only done the like, but have held them in subjection for centuries. On the other hand, there have been times when their western frontier advanced beyond the Elbe; indeed, it is asserted that they have sent colonies to Holland and even as far as southern England. A large part of eastern Germany; Bohemia, [292] Moravia, Hungary; the lower valley of the Danube and the Balkan peninsula, have been largely or completely Slavonised; and the Slavonic rule and language, which once had trouble to hold their own in West Russia and Little Russia, have now extended their sway over all the Finno-tataric populations of Great Russia; while they are advancing, among those of central Asia, up to the frontiers of India on the south and to the Pacific on the extreme

east. Thus it is hardly possible that fewer than three races should have contributed to the formation of the Slavonic people; namely, the blond long-heads, the European brunet broad-heads, and the Asiatic brunet broad-heads. And, in the absence of evidence to the contrary, it is certainly permissible to suppose that it is the first race which has furnished the blond complexion and the stature observable in so many, especially of the northern Slavs, and that the brunet complexion and the broad skulls must be attributed to the other two. But, if that supposition is permissible, then the Aryan form and substance of the Slavonic languages may also be fairly supposed to have proceeded from the blond long-heads. They could not have come from the Asiatic brunet broad-heads, who all speak non-Aryan languages; and the presumption is against their coming from the brunet broad-heads of the central European highlands, among whom an apparently non-Aryan [293] language was largely spoken, even in historical times.

In the same way, the tall blond tribes among the Fins may be accounted for as the product of admixture. The great majority of the Finno-tataric people are brunet broad-heads of the Asiatic type. But that the Fins proper have long been in contact with Aryans is evidenced by the many words borrowed from Aryan which their language contains. Hence there has been abundant opportunity for the mixture of races; and for the transference to some of the Fins of more or fewer of the physical characters of the Aryans and *vice versa.* On any hypothesis, the frontier between Aryan and Finno-tataric people must have extended across west-central Asia for a very long period; and, at any point of this frontier, it has been possible that mixed races of blond Fins or of brunet Aryans should be formed.

So much for the European people who now speak Celtic, or Teutonic, or Slavonian, or Lithuanian tongues; or who are known to have spoken them, before the supersession of so many of the early native dialects by the Romance modifications of the language of Rome. With respect to the original speakers of Greek and Latin, the unravelling of the tangled ethnology of the Balkan peninsula and the ordering of the chaos of that of Italy are enterprises upon which I do not propose [294] to enter. In regard to the first, however, there are a few tolerably satisfactory data. The ancient Thracians were proverbially blue-eyed and fair-haired. Tall blonds were common among the ancient Greeks, who were a long-headed people and the Sphakiots of Crete, probably the purest representatives of the old Hellenes in existence, are tall and blond. But considering that Greek colonization was taking place on a great scale in the eighth century B.C., and that, centuries earlier and later, the restless Hellene had been fighting trading, plundering and kidnapping, on both sides of the Ægean, and perhaps as far as the shores of Syria and of Egypt, it is probable that, even at the dawn of history, the maritime Greeks were a very mixed race. On the other hand, the Dorians may well have preserved the original type; and their famous migration may be the earliest known example of those movements of the Aryan race which were, in later times, to change the face of Europe. Analogy perhaps justifies a guess, that those ethnological shadows, the Pelasgi, may have been an earlier mixed population, like that of Western Gaul and of Britain before the Teutonic invasion. At any rate, the tall blond long-heads are so well represented in the oldest history of the Balkan peninsula, that they may be credited with the Aryan languages spoken there. And it may; be that the tradition which peopled Phrygia with Thracians represents a real move[295]ment of the Aryan race into Asia Minor, such as that which in after years carried the Gauls thither.

The difficulties in the way of a probable identification of the people among whom the various dialects of the Latin group developed themselves, with any race traceable in Italy in historical times, are very great.

In addition to the Italic "aborigines" northern Italy was peopled by Ligurian brunet broad-heads; with Gauls, probably, to a large extent, blond long-heads; with Illyrians, about whom nothing is known. Besides these, there were those perplexing people the Etruscans, who seem to have been, originally, brunet long-heads. South Italy and Sicily present a contingent of "Sikels," Phœnicians and Greeks; while over all, in comparatively modern times, follows a wash of Teutonic blood. The Latin dialects arose, no one knows how, among the tribes of Central Italy, encompassed on all sides by people of the most various physical characters, who were gradually absorbed into the eternally widening maw of Rome, and there, by dint of using the same speech, became the first example of that wonderful ethnological hotch-potch miscalled the Latin race. The only trustworthy guide here is archæological investigation. A great advance will have been made when the race characters of the pre-historic people of the terremare (who are identified by [296] Helbig[5] with the primitive Umbrians) become fully known.

I cannot learn that the ancient literatures of India and of Persia give any definite information about the complexion of the Indo-Iranians, beyond conveying the impression that they were what we vaguely call white men. But it is important to note that tall blond people make their appearance sporadically among the Tadjiks of Persia and of Turkestan; that the Siah-posh and Galtchas of the mountainous barrier between Turkestan and India are such; and that the same characters obtain largely among the Kurds on the western frontier of Persia, at the present day. The Kurds and the Galtchas are generally broad-headed, the others are long-headed. These people and the ancient Alans thus form a series of stepping-stones between the blond Aryans of Europe and those of Asia, standing up amidst the flood of Finno-tataric people which has inundated the rest of the interval between the sources of the Dnieper and those of the Oxus. If only more was known about the Sarmatians and the Scythians of the oldest historians, it is not improbable, I think, that we should discover that, even in historical times, the area occupied by the blond long-heads [297] of Aryan speech has been, at least temporarily, continuous from the shores of the North Sea to central Asia.

Suppose it to be admitted, as a fair working hypothesis, that the blond long-heads once extended without a break over this vast area, and that all the Aryan tongues have been developed out of their original speech, the question respecting the home of the race when the various families of Aryan speech were in the condition of inceptive dialects remains open. For all that, at first, appears to the contrary, it may have been in the west, or in the east, or anywhere between the two. In seeking for a solution of this obscure problem, it is an important preliminary to grasp the truth that the Aryan race must be much older than the primitive Aryan speech. It is not to be seriously imagined that the latter sprang suddenly into existence, by the act of a jealous Deity, apparently unaware of the strength of man's native tendency towards confusion of speech. But if all the diverse languages of men were not brought suddenly into existence, in order to frustrate the plans of the audacious bricklayers of the plain of Shinar; if this professedly historical statement is only another "type," and primitive Aryan, like all other languages, was built up by a secular process of development, the blond long-heads, among whom it grew into shape, must for [298] ages have been, philologically speaking, non-Aryans, or perhaps one should say "pro-Aryans." I suppose it may be safely assumed that Sanskrit and Zend and Greek were fully differentiated in the year 1500 B.C. If so, how much further back must the existence of the primitive Aryan, from which these proceeded, be dated? And how much further yet, that real *juventus mundi* (so far as man is concerned) when primitive Aryan was in course of formation? And how much further still,

the differentiation of the nascent Aryan blond long-head race from the primitive stock of mankind?

If any one maintains that the blond long-headed people, among whom, by the hypothesis, the primitive Aryan language was generated may have formed a separate race as far back as the pleistocene epoch, when the first unquestionable records of man make their appearance, I do not see that he goes beyond possibility–though, of course, that is a very different thing from proving his case. But, if the blond long-heads are thus ancient, the problem of their primitive seat puts on an altogether new aspect. Speculation must take into account climatal and geographical conditions widely different from those which obtain in northern Eurasia at the present day. During much of the vast length of the Pleistocene period, it would seem that men could no more have lived either in Britain north of the Thames, or in [299] Scandinavia, or in northern Germany, or in northern Russia, than they can live now in the interior of Greenland, seeing that the land was covered by a great ice sheet like that which at present shrouds the latter country. At that epoch, the blond long-heads cannot reasonably be supposed to have occupied the regions in which we meet with them in the oldest times of which history has kept a record.

But even if we are content to assume a vastly less antiquity for the Aryan race; if we only make the assumption, for which there is considerable positive warranty, that it has existed in Europe ever since the end of the Pleistocene period–when the fauna and flora assumed approximately their present condition and the state of things called Recent by geologists set in–we have to reckon with a distribution of land and water, not only very different from that which at present obtains in northern Eurasia, but of such a nature that it can hardly fail to have exerted a great influence on the development and the distribution of the races of mankind. (See page 250, note 2 [16].)

At the present time, four great separate bodies of water, the Black Sea, the Caspian, the Sea of Aral, and Lake Balkash, occupy the southern end of the vast plains which extend from the Arctic Sea to the highlands of the Balkan peninsula, of Asia Minor, of Persia, of Afghanistan, and of the high plateaus of central Asia, as far as the Altai. [300] They lie for the most part between the parallels of 40° and 50° N. and are separated by wide stretches of barren and salt-laden wastes. The surface of Balkash is 514 feet, that of the Aral 158 feet above the Mediterranean, that of the Caspian eighty-five feet below it. The Black Sea is in free communication with the Mediterranean by the Bosphorus and the Dardanelles; but the others, in historical times, have been, at most, temporarily connected with it and with one another, by relatively insignificant channels. This state of things, however, is comparatively modern. At no very distant period, the land of Asia Minor was continuous with that of Europe, across the present site of the Bosphorus, forming a barrier several hundred feet high, which dammed up the waters of the Black Sea. A vast extent of eastern Europe and of western central Asia thus became a huge reservoir, the lowest part of the lip of which was probably situated somewhat more than 200 feet above the sea level, along the present southern watershed of the Obi, which flows into the Arctic Ocean. Into this basin, the largest rivers of Europe, such as the Danube and the Volga, and what were then great rivers of Asia, the Oxus and Jaxartes, with all the intermediate affluents, poured their waters. In addition, it received the overflow of Lake Balkash, then much larger; and probably, that of the inland sea of Mongolia. At that time, the level of the Sea of Aral stood at [301] least 60 feet higher than it does at present.[6] Instead of the separate Black, Caspian, and Aral seas, there was one vast Ponto-Aralian Mediterranean, which must have been

prolonged into arms and fiords along the lower valleys of the Danube, the Volga (in the course of which Caspian shells are now found as far as the Kuma), the Ural, and the other affluent rivers–while it seems to have sent its overflow, northward, through the present basin of the Obi. At the same time, there is reason to believe that the northern coast of Asia, which everywhere shows signs of recent slow upheaval, was situated far to the south of its present position. The consequences of this state of things have an extremely important bearing on the question under discussion. In the first place, an insular climate must be substituted for the present extremely continental climate of west central Eurasia. That is an important fact in many ways. For example, the present eastern climatal limitations of the beech could not have existed, and if primitive Aryan goes back thus far, the arguments based upon the occurrence of its name in some Aryan languages and not in others lose their force. In the second place, the European and the Asiatic moieties of the great Eurasiatic [302] plains were cut off from one another by the Ponto-Aralian Mediterranean and its prolongations. In the third place, direct access to Asia Minor, to the Caucasus, to the Persian highlands, and to Afghanistan, from the European moiety was completely barred; while the tribes of eastern central Asia were equally shut out from Persia and from India by huge mountain ranges and table lands. Thus, if the blond long-head race existed so far back as the epoch in which the Ponto-Aralian Mediterranean had its full extension, space for its development, under the most favourable conditions, and free from any serious intrusion of foreign elements from Asia, was presented in northern and eastern Europe.

When the slow erosion of the passage of the Dardanelles drained the Ponto-Aralian waters into the Mediterranean, they must have everywhere fallen as near the level of the latter as the make of the country permitted, remaining, at first, connected by such straits as that of which the traces yet persist between the Black and the Caspian, the Caspian and the Aral Seas respectively. Then, the gradual elevation of the land of northern Siberia, bringing in its train a continental climate, with its dry air and intense summer heats, the loss by evaporation soon exceeded the greatly reduced supply of water, and Balkash, Aral, and Caspian gradually shrank to their present dimensions. In the course of this process, the broad [303] plains between the separated inland seas, as soon as they were laid bare, threw open easy routes to the Caucasus and to Turkestan, which might well be utilised by the blond long-heads moving eastward through the plains, contemporaneously left dry, south and east of the Ural chain. The same process of desiccation, however, would render the route from east central Asia westward as easily practicable; and, in the end, the Aryan stock might easily be cut in two, as we now find it to be, by the movement of the Mongoloid brunet broad-heads to the west.

Thus we arrive at what is practically Latham's Sarmatian hypothesis–if the term "Sarmatian" is stretched a little, so as to include the higher parts and a good deal of the northern slopes of Europe between the Ural and the German Ocean; an immense area of country, at least as large as that now included between the Black Sea, the Atlantic, the Baltic, and the Mediterranean.

If we imagine the blond long-head race to have been spread over this area, while the primitive Aryan language was in course of formation, its north-western and its southeastern tribes will have been 1,500, or more, miles apart. Thus, there will have been ample scope for linguistic differentiation; and, as adjacent tribes were probably influenced by the same causes, it is reasonable to suppose that, at any given region of the periphery the process of differentiation, whether brought [304] about by internal or

external agencies, will have been analogous. Hence, it is permissible to imagine that, even before primitive Aryan had attained its full development, the course of that development had become somewhat different in different localities; and, in this sense, it may be quite true that one uniform primitive Aryan language never existed. The nascent mode of speech may very early have got a twist, so to speak, towards Lithuanian, Slavonian, Teutonic, or Celtic, in the north and west; towards Thracian and Greek, in the south-west; towards Armenian in the south; towards Indo-Iranian in the southeast. With the centrifugal movements of the several fractions of the race, these tendencies of peripheral groups would naturally become more and more intensified in proportion to their isolation. No doubt, in the centre and in other parts of the periphery of the Aryan region, other dialectic groups made their appearance; but whatever development they may have attained, these have failed to maintain themselves in the battle with the Finno-tataric tribes, or with the stronger among their own kith and kin.[7]

Thus I think that the most plausible hypothetical answers which can be given to the two questions which we put at starting are these. [305] There was and is an Aryan race–that is to say, the characteristic modes of speech, termed Aryan, were developed among the blond long-heads alone however much some of them may have been modified by the importation of non-Aryan elements. As to the "home" of the Aryan race, it was in Europe, and lay chiefly east of the central highlands and west of the Ural. From this region it spread west, along the coasts of the North Sea to our islands, where, probably, it met the brunet long-heads; to France, where it found both these and the brunet short-heads; to Switzerland and South Germany, where it impinged on the brunet short-heads; to Italy, where brunet short-heads seem to have abounded in the north and long-heads in the south; and to the Balkan peninsula, about the earliest inhabitants of which we know next to nothing. There are two ways to Asia Minor, the one over the Bosphorus and the other through the passes of the Caucasus, and the Aryans may well have utilised both. Finally, the south-eastern tribes probably spread themselves gradually over west Turkestan, and, after evolving the primitive Indo-Iranian dialect, eventually colonized Persia and Hindostan, where their speech developed into its final forms. On this hypothesis, the notion that the Celts and the Teutons migrated from about Pamir and the Hindoo-Koosh is as far from the truth as the supposition that the Indo-Iranians migrated from [306] Scandinavia. It supposes that the blond long-heads, in what may be called their nascent Aryan stage, that is before their dialects had taken on the full Aryan characteristics, were spread over a wide region which is, conventionally, European; but which, from the point of view of the physical geographer, is rather to be regarded as a continuation of Asia. Moreover, it is quite possible and even probable, that the blond long-heads may have arrived in Turkestan before their language had reached, or at any rate passed beyond, the stage of primitive Aryan; and that the whole process of differentiation into Indo-Iranian took place during the long ages of their residence in the basin of the Oxus. Thus, the question whether the seat of the primitive Aryans was in Europe, or in Asia, becomes very much a debate about geographical terminology.

The foregoing arguments in favour of Latham's "Sarmatian hypothesis" have been based upon data which lie within the ken of history or may be surely concluded by reasoning backwards from the present state of things. But, thanks to the investigations of the pre-historic archæologists and anthropologists during the last half-century, a vast mass of positive evidence respecting the distribution and the condition of mankind in the long interval between the dawn of history and the commencement of the recent epoch has been brought to light.

[307] During this period, there is evidence that men existed in all those regions of Europe which have yet been properly examined; and such of their bony remains as have been discovered exhibit no less diversity of stature and cranial conformation than at present. There are tall and short men; long-skulled and broad-skulled men; and it is probably safe to conclude that the present contrast of blonds and brunets existed among them when they were in the flesh. Moreover it has become clear that, everywhere, the oldest of these people were in the so-called neolithic stage of civilization. That is to say, they not merely used stone implements which were chipped into shape, but they also employed tools and weapons brought to an edge by grinding. At first they know little or nothing of the use of metals; they possess domestic animals and cultivated plants and live in houses of simple construction.

In some parts of Europe little advance seems to have been made, even down to historical times. But in Britain, France, Scandinavia, Germany, Western Russia, Switzerland, Austria, the plain of the Po, very probably also in the Balkan peninsula, culture gradually advanced until a relatively high degree of civilization was attained. The initial impulse in this course of progress appears to have been given by the discovery that metal is a better material for tools and weapons than stone. In the early days of pre-historic archæ[308]ology, Nilsson showed that, in the interments of the middle age, bronze largely took the place of stone, and that, only in the latest, was iron substituted for bronze. Thus arose the generalization of the occurrence of a regular succession of stages of culture, which were somewhat unfortunately denominated the "ages" of stone, bronze, and iron. For a long time after this order of succession in the same locality (which, it was sometimes forgotten, has nothing to do with chronological contemporaneity in different localities) was made out, the change from stone to bronze was ascribed to foreign, and, of course, Eastern influences. There were the ubiquitous Phœnician traders and the immigrant Aryans from the Hindoo-Koosh, ready to hand. But further investigation has proved[8] for various parts of Europe and made it probable for others, that though the old order of succession is correct it is incomplete, and that a copper stage must be interpolated between the neolithic and the bronze stages. Bronze is an artificial product, the formation of which implies a knowledge of copper; and it is certain that copper was, at a very early period, smelted out of the native ores, by the people of central Europe who used it. When they learned that the hard[309]ness and toughness of their metal were immensely improved by alloying it with a small quantity of tin, they forsook copper for bronze, and gradually attained a wonderful skill in bronze work. Finally, some of the European people became acquainted with iron, and its superior qualities drove out bronze, as bronze had driven out stone, from use in the manufacture of implements and weapons of the best class. But the process of substitution of copper and bronze for stone was gradual, and, for common purposes, stone remained in use long after the introduction of metals.

The pile-dwellings of Switzerland have yielded an unbroken archæological record of these changes. Those of eastern Switzerland ceased to exist soon after the appearance of metals, but in those of the Lakes of Neuchatel and Bienne the history is continued through the stage of bronze to the beginning of that of iron. And in all this lone series of remains, which lay bare the minutest details of the life of the pile-dwellers, from the neolithic to the perfected bronze stage, there is no indication of any disturbance such as must have been caused by foreign invasion; and such as was produced by intruders, shortly after

the iron stage was reached. Undoubtedly the constructors of the pile-dwellings must have received foreign influences through the channel of trade, and may have received them by the slow immigration of other races. Their amber, their jade, and their [310] tin show that they had commercial intercourse with somewhat distant regions. The amber, however, takes us no further than the Baltic; and it is now known that jade is to be had within the boundaries of Europe, while tin lay no further off than north Italy. An argument in favour of oriental influence has been based upon the characters of certain of the cultivated plants and domesticated animals. But even that argument does not necessarily take us beyond the limits of south-eastern Europe; and it needs reconsideration in view of the changes of physical geography and of climate to which I have drawn attention.

In connection with this question there is another important series of facts to be taken into consideration. When, in the seventeenth century, the Russians advanced beyond the Ural and began to occupy Siberia, they found that the majority of the natives used implements of stone and bone. Only a few possessed tools or weapons of iron, which had reached them by way of commerce; the Ostiaks and the Tartars of Tom, alone, extracted their iron from the ore. It was not until the invaders reached the Lena, in the far east, that they met with skilful smiths among the Jakuts[9] who manufactured knives, axes, lances, battle-axes, and leather jerkins studded with iron; [311] and among the Tunguses and Lamuts, who had learned from the Jakuts.

But there is an older chapter of Siberian history which was closed in the seventeenth century, as that of the people of the pile-dwellings of Switzerland had ended when the Romans entered Helvetia. Multitudes of sepulchral tumuli, termed like those of European Russia, "kurgans," are scattered over the north Asiatic plains, and are especially agglomerated about the upper waters of the Jenisei. Some are modern, while others, extremely ancient, are attributed to a quasi-mythical people, the Tschudes. These Tschudish kurgans abound in copper and gold articles of use and luxury, but contain neither bronze nor iron. The Tschudes procured their copper and their gold from the metalliferous rocks of the Ural and the Altai; and their old shafts, adits, and rubbish heaps led the Russians to the rediscovery of the forgotten stores of wealth. The race to which the Tschudes belonged and the age of the works which testify to their former existence, are alike unknown. But seeing that a rumour of them appears to have reached Herodotus, while, on the other hand, the pile-dwelling civilization of Switzerland may perhaps come down as late as the fifth century B.C., the [312] possibility that a knowledge of the technical value of copper may have travelled from Siberia westward must not be overlooked. If the idea of turning metals to account must needs be Asiatic, it may be north Asiatic just as well as south Asiatic. In the total absence of trustworthy chronological and anthropological data, speculation may run wild.

The oldest civilizations for which we have an, even approximately, accurate chronology are those of the valleys of the Nile and of the Euphrates. Here, culture seems to have attained a degree of perfection, at least as high as that of the bronze stage, six thousand years ago. But before the intermediation of Etruscan, Phœnician, and Greek traders, there is no evidence that they exerted any serious influence upon Europe or northern Asia. As to the old civilization of Mesopotamia, what is to be said until something definite is known about the racial characters of its originators, the Accadians? As matters stand, they are just as likely to have been a group of the same race as the Egyptians, or the Dravidians,

as anything else. And considering that their culture developed in the extreme south of the Euphrates valley, it is difficult to imagine that its influence could have spread to northern Eurasia except by the Phœnician (and Carian?) intermediation which was undoubtedly operative in comparatively late times.

[313] Are we then to bring down the discovery of the use of copper in Switzerland to, at earliest, 1500 B. C., and to put it down to Phœnician hints? But why copper? At that time the Phœnicians must have been familiar with the use of bronze. And if, on the other hand, the northern Eurasiatics had got as far as copper, by the help of their own ingenuity, why deny them the capacity to make the further step to bronze? Carry back the borrowing system as far as we may, in the end we must needs come to some man or men from whom the novel idea started, and who after many trials and errors gave it practical shape. And there really is no ground in the nature of things for supposing that such men of practical genius may not have turned up, independently, in more races than one.

The capacity of the population of Europe for independent progress while in the copper and early bronze stage–the "palæo-metallic" stage, as it might be called–appears to me to be demonstrated in a remarkable manner by the remains of their architecture. From the crannog to the elaborate pile-dwelling, and from the rudest enclosure to the complex fortification of the terramare, there is an advance which is obviously a native product. So with the sepulchral constructions; the stone cist, with or without a preservative or memorial cairn, grows into the chambered graves lodged in tumuli; into such [314] megalithic edifices as the dromic vaults of Maes How and New Grange; to culminate in the finished masonry of the tombs of Mycenæ, constructed on exactly the same plan. Can any one look at the varied series of forms which lie between the primitive five or six flat stones fitted together into a mere box, and such a building as Maes How, and yet imagine that the latter is the result of foreign tuition? But the men who built Maes How, without metal tools, could certainly have built the so-called "treasure-house" of Mycenæ, with them.

If these old men of the sea, the heights of Hindoo-Koosh-Pamir and the plain of Shinar, had been less firmly seated upon the shoulders of anthropologists, I think they would long since have seen that it is at least possible that the early civilization of Europe is of indigenous growth; and that, so far as the evidence at present accumulated goes, the neolithic culture may have attained its full development, copper may have gradually come into use, and bronze may have succeeded copper, without foreign intervention.

So far as I am aware, every raw material employed in Europe up to the palæo-metallic stage is to be found within the limits of Europe; and there is no proof that the old races of domesticated animals and plants could not have been developed within these limits. If any one chose to main[315]tain, that the use of bronze in Europe originated among the inhabitants of Etruria and radiated thence, along the already established lines of traffic to all parts of Europe, I do not see that his contention could be upset. It would be hard to prove either that the primitive Etruscans could not have discovered the way to manufacture bronze, or that they did not discover it and become a great mercantile people in consequence, before Phœnician commerce had reached the remote shores of the Tyrrhene Sea.

Can it be safely concluded that the palæo-metallic culture which we have been considering was the appanage of any one of the western Eurasiatic races rather than another? Did it arise and develop among the brunet or the blond long-heads, or among the brunet short-heads? I do not think there are any means of answering these questions, positively, at present. Schrader has pointed out that the state of culture of the primitive Aryans, deduced from philological data, closely corresponds with that which obtained among the pile-dwellers in the neolithic stage. But the resemblance of the early stages of civilisation among the most different and widely separated races of mankind, should warn us that archæology is no more a sure guide in questions of race than philology.

With respect to the osteological characters of [316] the people of the Swiss pile-dwellings information is as yet scanty. So far as the present evidence goes, they appear to have comprised both broad-heads and long-heads of moderate stature.[10] In France, England, and Germany, both long and broad skulls are found in tumuli belonging to the neolithic stage. In some parts of England the long skulls, and in others the broad skulls, accompany the higher stature. In the Scandinavian peninsula, nine-tenths of the neolithic people are decided long-heads: in Denmark, there is a much larger proportion of broad-heads.

In view of all the facts known to me (which cannot be stated in greater detail in this place), I am disposed to think that the blond long-heads, the brunet long-heads, and the brunet broad-heads have existed on the continent of Europe throughout the Recent period: that only the former two at first inhabited our islands; but that a mixed race of tall broad-heads, like some of the Blackforesters of the present day, so excellently described by Ecker, migrated from the continent and formed that tall contingent of the population [317] which has been identified (rightly or wrongly) with the Belgæ by Thurnam and which seems to have subsequently lost itself among the predominant brunet and blond long-heads.

I do not think there is anything to warrant the conclusion that the palæo-metallic culture of Europe took its origin among the blond long-head (or supposed Aryan) race; or that the people of the Swiss pile-dwellings belonged to that race. The long-heads among them may just as likely have been brunets. In north-eastern Italy there is clear evidence of the superposition of at least four stages of culture, in which that of the copper and bronze using terramare people comes second; a stage marked by Etruscan domination occupies the third place; and that is followed by the stage which appertains to the Gauls, with their long swords and other characteristic iron work. In western Switzerland, on the other hand, at La Téne, and elsewhere, similar relics show that the Gauls followed upon the latest population of the pile-dwellings among whom traces of Etruscan influence (though not of dominion) are to be found. Helbig supposes the terramare people to have been Greco-Latin-speaking Pelasgi, and consequently Aryan. But we cannot suppose the people of the pile-dwellings of Switzerland to have been speakers of primitive Greco-Latin (if ever there was such a language). And if the Gauls were the first speakers of Celtic who got into Switzerland, [318] what Aryan language can the people of the pile-dwellings have spoken?[11]

As I have already mentioned, there is not the least doubt that man existed in north-western Europe during the Pleistocene or Quaternary epoch. It is not only certain that men were contemporaries of the

mammoth, the hairy rhinoceros, the reindeer, the cave bear, and other great carnivora, in England and in France, but a great deal has been ascertained about the modes of life of our predecessors. They were savage hunters, who took advantage of such natural shelters as overhanging rocks and caves, and perhaps built themselves rough wigwams; but who had no domestic animals and have left no sign that they cultivated plants. In many localities there is evidence that a very considerable interval–the so-called *hiatus*– intervened between the time when the Quaternary or palæolithic men occupied particular caves and river basins and the accumulation of the debris left by their neolithic successors. And, in spite of all the warnings against negative evidence afforded by the history of geology, some have very positively asserted that this means a complete break between the Quater[319]nary and the Recent populations–that the Quaternary population followed the retreating ice northwards and left behind them a desert which remained unpeopled for ages. Other high authorities, on the contrary, have maintained that the races of men who now inhabit Europe may all be traced back to the Great Ice Age. When a conflict of opinion of this kind obtains among reasonable and instructed men, it is generally a safe conclusion that the evidence for neither view is worth much. Certainly that is the result of my own cogitations with regard to both the hiatus doctrine (in its extreme form) and its opposite–though I think the latter by much the more likely to turn out right. But I hesitate to adopt it on the evidence which has been obtained up to this time.

No doubt, human bones and skulls of various types have been discovered in close proximity to Palæolithic implements and to skeletons of quaternary quadrupeds; no doubt, if the bones and skulls in question were not human, their contemporaneity would hardly have been questioned. But, since they are human, the demand for further evidence really need not be ascribed to mere conservative prejudice. Because the human biped differs from all other bipeds and quadrupeds, in the tendency to put his dead out of sight in various ways; commonly by burial. It is a habit worthy of all respect in itself, but generative of subtle traps and grievous pitfalls for the unwary [320] investigator of human palæontology. For it may easily happen, that the bones of him that "died o' Wednesday," may thus come to lie alongside the bones of animals that were extinct thousands of years before that Wednesday; and yet the interment may have been effected so many thousands of years ago that no outward sign betrays the difference in date. In all investigations of this kind, the most careful and critical study of the circumstances is needful if the results are to be accepted as perfectly trustworthy.

In the case of the remains found in a cave of the valley of the Neander, near Düsseldorf, half a century ago–the characters of which gave rise to a vast amount of discussion at that time and subsequently–the circumstances of the discovery were but vaguely known. The skeleton was met with in a deposit, the loess, which is known to be of quaternary age; there was no evidence to show how it came there. Consequently, not only was its exact age justly and properly declared to be a matter of doubt; but those who, on scientific or other grounds, were inclined to minimise its importance could put forth plausible speculations about its nature which do not look so well under the light thrown by a more advanced science of Anthropology. It could be and it was suggested that the Neanderthal skeleton was that of a strayed idiot; that the characters of the skull were the result of early synostosis or of late gout; and, [321] in fact, any stick was good enough to beat the dog withal.

As some writings of mine on the subject led to my occupation of a prominent position among the

belaboured dogs of that day, I have taken a mild interest in watching the gradual rehabilitation of my old friend of the Neanderthal among normal men, which has been going on of late years. It has come to be generally admitted that his remarkable cranium is no more than a strongly-marked example of a type which occurs, not only among other prehistoric men, but is met with, sporadically, among the moderns; and that, after all, I was not so wrong as I ought to have been, when I indicated such points of similarity among the skulls found in our river-beds and among the native races of Australia.[12] However, doubts still clung about the geological age of the various deposits in which skulls of the Neanderthal type were subsequently found; and it was not until the year 1886 that two highly-competent observers, Messrs. Fraipont and Lohest, the one an anatomist, the other a geologist, furnished us with evidence such as will bear severe criticism. At the mouth of a cave in the commune of Spy, in the Belgian province of Namur, Messrs. Fraipont and Lohest discovered two skeletons of the Neanderthal type; and the elaborate account of their investigations which they have published appears to me to leave [322] little room for doubt that the men of Spy fabricated the Paleolithic implements, and were the contemporaries of the characteristic quaternary quadrupeds, found with them. The anatomical characters of the skeletons bear out conclusions which are not flattering to the appearance of the owners. They were short of stature but powerfully built, with strong, curiously-curved, thighbones, the lower ends of which are so fashioned that they must have walked with a bend at the knees. Their long depressed skulls had very strong brow ridges; their lower jaws, of brutal depth and solidity, sloped away from the teeth downwards and backwards, in consequence of the absence of that especially characteristic feature of the higher type of man, the chin prominence. Thus these skulls are not only eminently "Neanderthaloid," but they supply the proof that the parts wanting in the original specimen harmonized in lowness of type with the rest.

After a very full discussion of the anatomical characters of these skulls, M. Fraipont says:

"To sum up, we consider ourselves to be in a position to say that, having regard merely to the anatomical structure of the man of Spy, he possessed a greater number of pithecoid characters than any other race of mankind."[13]

And after enumerating these he continues:

"The other and much more numerous characters of the skull, of [323] the trunk, and of the limbs seem to be all human. Between the man of Spy and an existing anthropoid ape there lies an abyss."

Now that is pleasant reading for me, because, in 1863, I committed myself to the assertion that the Neanderthal skull was "the most pithecoid of human crania yet discovered," yet that "in no sense can the Neanderthal bones be regarded as the remains of a human being intermediate between men and apes"[14] and "that the fossil remains of Man hitherto discovered do not seem to me to take us appreciably nearer to that lower pithecoid form, by the modification of which he has, probably, become what he is."[15]

As the evidence stood seven and twenty years ago, in fact, it would have been imprudent to assume that the Neanderthal skull was anything but a case of sporadic reversion. But, in my anxiety not to overstate my case, I understated it. The Neanderthaloid race is "appreciably nearer," though the approximation is

but slight. In the words of M. Fraipont:

"The distance which separates the man of Spy from the modern anthropoid ape is undoubtedly enormous; between the man of Spy and the *Dryopithecus* it is a little less. But we must be permitted to point out that if the man of the later quaternary age is the stock whence existing races have sprung, he has travelled a very great way.

From the data now obtained, it is permissible to believe that [324] we shall be able to pursue the ancestral type of men and the anthropoid apes still further, perhaps as far as the eocene and even beyond."[16]

These conclusions hold good whatever the age of the men of Spy; but they possess a peculiar interest if we admit, as I think on the evidence must be admitted, that these human fossils are of pleistocene age. For, after all due limitations, they give us some, however dim, insight into the rate of evolution of the human species, and indicate that it has not taken place at a much faster or slower pace than that of other mammalia. And if that is so, we are warranted in the supposition that the genus *Homo,* if not the species which the courtesy or the irony of naturalists has dubbed *sapiens,* was represented in pliocene, or even in miocene times. But I do not know by what osteological peculiarities it could be determined whether the pliocene, or miocene, man was sufficiently sapient to speak or not;[17] and whether, or not, he answered to the definition "rational animal" in any higher sense than a dog or an ape does.

There is no reason to suppose that the genus [325] *Homo* was confined to Europe in the Pleistocene age; it is much more probable that this, like other mammalian genera of that period, was spread over a large extent of the surface of the globe. At that time, in fact, the climate of regions nearer the equator must have been far more favourable to the human species; and it is possible that, under such conditions, it may have attained a higher development than in the north. As to where the genus *Homo* originated, it is impossible to form even a probable guess. During the miocene epoch, one region of the present temperate zones would serve as well as another. The elder Agassiz long ago tried to prove that the well-marked areas of geographical distribution of mammals have their special kinds of men; and, though this doctrine cannot be made good to the extent which Agassiz maintained; yet the limitation of the Australian type to New Holland,[18] the approximate restriction of the negro type to Ultra-Saharal Africa, and the peculiar character of the population of Central and South America, are facts which bear strongly in favour of the conclusion that the causes which have influenced the distribution of mammals in general, have powerfully affected that of man.

Let it be supposed that the human remains from the caves of the Neanderthal and of Spy [326] represent the race, or one of the races, of men who inhabited Europe in the quaternary epoch, can any connection be traced between it and existing races? That is to say, do any of them exhibit characters approximating those of the Spy men or other examples of the Neanderthaloid race? Put in the latter form, I think that the question may be safely answered in the affirmative. Skulls do occasionally approach the Neanderthaloid type, among both the brunet and the blond long-head races. For the former, I pointed out

the resemblance, long ago, in some of the Irish river-bed skulls. For the latter, evidence of various kinds may be adduced; but I prefer to cite the authority of one of the most accomplished and cautious of living anthropologists. Professor Virchow was led, by historical considerations, to think that the Teutonic type, if it still remained pure and undefiled anywhere, should be discoverable among the Frisians, in their ancient island homes on the North German coast, remote from the great movements of nations. In their tall stature and blond complexion the Frisians fulfilled expectation; but their skulls differed in some respects from those of the neighbouring blond long-heads. The depression, or flattening (accompanied by a slight increase in breadth), which occurs occasionally among the latter, is regular and characteristic among the Frisians; and, in other respects, the Frisian skull unmistakably approaches the Nean[327] derthal and Spy type.[19] The fact that this resemblance exists is of none the less importance because the proper interpretation of it is not yet clear. It may be taken to be a pretty sure indication of the physiological continuity of the blond long-heads with the Pleistocene Neanderthaloid men. But this continuity may have been brought about in two ways. The blond long-heads may exhibit one of the lines of evolution of the men of the Neanderthaloid type. Or, the Frisians may be the result of the admixture of the blond long-heads with Neanderthaloid men; whose remains have been found at Canstatt and at Gibraltar, as well as at Spy and in the valley of the Neander; and who, therefore, seem, at one time, to have occupied a considerable area in Western Europe. The same alternatives present themselves when Neanderthaloid characters appear in skulls of other races. If these characters belong to a stage in the development of the human species, antecedent to the differentiation of any of the existing races, we may expect to find them in the lowest of these races, all over the world, and in the early stages of all races. I have already referred to the remarkable similarity of the skulls of certain tribes of native Australians to the [328] Neanderthal skull; and I may add, that the wide differences in height between the skulls of different tribes of Australians afford a parallel to the differences in altitude between the skulls of the men of Spy and those of the grave rows of North Germany. Neanderthaloid features are to be met with, not only in ancient long skulls; those of the ancient broad-headed people entombed at Borreby in Denmark have been often noted.

Reckoned by centuries, the remoteness of the quaternary, or Pleistocene, age from our own is immense, and it is difficult to form an adequate notion of its duration. Undoubtedly there is an abysmal difference between the Neanderthaloid race and the comely living specimens of the blond long-heads with whom we are familiar. But the abyss of time between the period at which North Europe was first covered with ice, when savages pursued mammoths and scratched their portraits with sharp stones in central France, and the present day, ever widens as we learn more about the events which bridge it. And, if the differences between the Neanderthaloid men and ourselves could be divided into as many parts as that time contains centuries, the progress from part to part would probably be almost imperceptible.

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[1] Schrader, *Prehistoric Antiquities of the Aryan Peoples.* Translated by F. B. Jevons, M.A., 1890. Taylor, *The Origin of the Aryans,* 1890.

[2] Canon Taylor (*Origin of the Aryans*, p. 31) states that "Cuno . . . was the first to insist on what is now looked on

as an axiom in ethnology–that race is not co-extensive with language," in a work published in 1871. I may be permitted to quote a passage from a lecture delivered on the 9th of January, 1870, which brought me into a great deal of trouble. "Physical, mental, and moral peculiarities go with blood and not with language. In the United States the negroes have spoken English for generations; but no one on that ground would call them Englishmen, or expect them to differ physically, mentally or morally from other negroes "–*Pall Mall Gazette*, Jan. 10, 1870. But the "axiom in ethnology" had been implied if not enunciated, before my time; for example, by Desmoulins in 1826 (See above p. 215.)

[3] I am unable to discover good grounds for the severity of the criticism, in the name of "the anthropologists," with which Professor Max Müller's assertion that the same blood runs in the veins of English soldiers "as in the veins of the dark Bengalese," and that there is "a legitimate relationship between Hindoo, Greek, and Teuton," has been visited. So far as I know anything about anthropology, I should say that these statements may be correct literally, and probably are so substantially. I do not know of any good reason for the physical differences between a high-caste Hindoo and a Dravidian, except the Aryan blood in the veins of the former; and the strength of the infusion is probably quite as great in some Hindoos as in some English soldiers.

[4] I may plead the precedent of the good English words "block-head" and "thick-head" for "broad-head" and "long-head." but I cannot say that they are elegant. I might have employed the technical terms brachycephali and dolichocephali. But it cannot be said that they are much more graceful; and, moreover, they are sometimes employed in senses different from that which I have given in the definition of broad-heads and long-heads. The *cephalic index* is a number which expresses the relation of the breadth to the length of a skull, taking the latter as 100. Therefore "broad-heads" have the cephalic index above 80 and "long-heads" have it below 80. The physiological value of the difference is unknown; its morphological value depends upon the observed fact of the constancy of the occurrence of either long skulls or broad skulls among large bodies of mankind.

[5] *Die Italiker in der Poebene,* 1879. See for much valuable information respecting the races of the Balkan and Italic peninsulæ, Zampa's essay, "Vergleichende Anthropolologische Ethnographie von Apulien," *Zeitschrift für Ethnologie,* xviii., 1886.

[6] This is proved by the old shore-marks on the hill of Kashkanatao in the midst of the delta of the Oxus. Some authorities put the ancient level very much higher–200 feet or more (Keane, *Asia,* p. 408).

[7] See the views of J. Schmidt (stated and discussed in Schrader and Jevons, pp. 63-67), with which those here set forth are substantially identical.

[8] "Proved" is perhaps too strong a word. But the evidence set forth by Dr. Much (*Die Kupferzeit in Europa,* 1886) in favor of a copper stage of culture among the inhabitants of the pile-dwellings is very weighty.

[9] Andree, *Die Metalle bei den Naturvölkern* (p. 114). It is interesting to note that the Jakuts have always been pastoral nomads, formerly shepherds, now horse-breeders, and that they continue to work their iron in the primitive fashion; as the argument that metallurgic skill implies settled agricultural life not unfrequently makes its appearance.

[10] Professor Virchow has guardedly expressed the opinion that the oldest inhabitants of the Swiss pile-dwellings

were broad-heads, and that later on (commencing before the bronze stage there was a gradual infusion of long-heads among them (*Zeitshrift für Ethnologie.* xvii., 1885). There is independent evidence of the existence of broad-heads in the Cevennes during the neolithic period, and I should be disposed to think that this opinion may well be correct; but the examination of the evidence on which it is, at present, based does not lead me to feel very confident about it.

[11] See Dr. Munro's excellent work, *The Lake Dwellings of Europe,* for La Téne. Readers of Professor Rhys' recent articles (*Scottish Review,* 1890) may suggest that the pile dwelling people spoke the Gaedhelic form of Celtic, and the Gauls the Brythonic form.

[12] See p. 202 of this volume.

[13] Fraipont et Lohest. "La Race humaine de Néanderthal, ou de Canstatt, en Belgique," *Archives de Biologie,* 1886.

[14] See p. 205 *supra.*

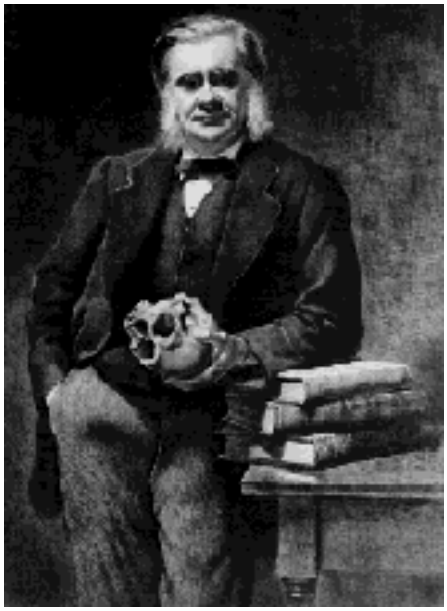
[15] *Ibid,* p. 208.

[16] "Where, then, must we look for primæval Man? Was the oldest *Homo sapiens,* pliocene or miocene, or yet more ancient? In still older strata do the fossilized bones of an Ape more anthropoid or a Man more pithecoid than any yet known await the researches of some unborn palæontologist? "–P. 208 *supra.*.

[17] I am perplexed by the importance attached by some to the presence or absence of the so-called "genial" elevations. Does any one suppose that the existence of the genio-hyo-glossus muscle which plays so large a part in the movements of the tongue depends on that of these elevations?

[18] [Unless I am right in extending it to Hindostan and even further west.–1894.]

[19] Virchow *Beiträge zur physischen Anthropologie der Deutschen (Abh. der Königlichen Akademie der Wissenschaften zu Berlin,* 1876). See particularly p. 238 for the full recognition of the Neanderthaloid characters of Frisian skulls and of the ethnological significaince of the similarity.



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Previous article: On Some Fixed Points in British Ethnology [1871], pages 253-270.

Next volume, Volume VIII, *Discourses: Biological & Geological,* of Huxley's *Collected Essays.*

On Some of the Results of the Expedition of H.M.S. *Challenger*

The Contemporry Review (1875)

Collected Essays VIII

[69] In May, 1873, I drew attention[1] to the important problems connected with the physics and natural history of the sea, to the solution of which there was every reason to hope the cruise of H.M.S. *Challenger* would furnish important contributions. The expectation then expressed has not been disappointed. Reports to the Admiralty, papers communicated to the Royal Society, and large collections which have already been sent home, have shown that the *Challenger's* staff have made admirable use of their great opportunities; and that, on the return of the expedition in 1874, their performance will be fully up to the level of their promise. Indeed, I am disposed to go so far as to say, that if nothing more came of the *Challenger 's* expedition than [70] has hitherto been yielded by her exploration of the nature of the sea bottom at great depths, a full scientific equivalent of the trouble and expense of her equipment would have been obtained.

In order to justify this assertion, and yet, at the same time, not to claim more for Professor Wyville Thomson and his colleagues than is their due, I must give a brief history of the observations which have preceded their exploration of this recondite field of research, and endeavour to make clear what was the state of knowledge in December, 1872, and what new facts have been added by the scientific staff of the *Challenger*. So far as I have been able to discover, the first successful attempt to bring up from great depths more of the sea bottom than would adhere to a sounding-lead, was made by Sir John Ross, in the voyage to the Arctic regions which he undertook in 1818. In the Appendix to the narrative of that voyage, there will be found an account of a very ingenious apparatus called "clams"–a sort of double scoop–of his own contrivance, which Sir John Ross had made by the ship's armourer; and by which, being in Baffin's Bay, in 72° 30' N. and 77° 15' W., he succeeded in bringing up from 1,050 fathoms (or 6,300 feet), "several pounds" of a "fine green mud," which formed the bottom of the sea in this region. Captain (now Sir Edward) Sabine, who accompanied Sir John Ross on this cruise, says of this mud that it was "soft and greenish, and that [71] the lead sunk several feet into it." A similar "fine green mud" was found to compose the sea bottom in Davis Straits by Goodsir in 1845. Nothing is certainly known of the exact nature of the mud thus obtained, but we shall see that the mud of the bottom of the Antarctic seas is described in curiously similar terms by Dr. Hooker, and there is no doubt as to the composition of this deposit.

In 1850, Captain Penny collected in Assistance Bay, in Kingston Bay, and in Melville Bay, which lie between 73° 45' and 74° 40' N., specimens of the residuum left by melted surface ice, and of the sea bottom in these localities. Dr. Dickie, of Aberdeen, sent these materials to Ehrenberg, who made out[2] that the residuum of the melted ice consisted for the most part of the silicious cases of diatomaceous plants, and of the silicious spicula of sponges; while, mixed with these, were a certain number of the equally silicious skeletons of those low animal organisms, which were termed *Polycistineæ* by

Ehrenberg, but are now known as *Radiolaria.*

In 1856, a very remarkable addition to our knowledge of the nature of the sea bottom in high northern latitudes was made by Professor Bailey of West Point. Lieutenant Brooke, of the United States Navy, who was employed in surveying the [72] Sea of Kamschatka, had succeeded in obtaining specimens of the sea bottom from greater depths than any hitherto reached, namely from 2,700 fathoms (16,200 feet) in 56° 46' N., and 168° 18' E.; and from 1,700 fathoms (10,200 feet) in 60° 15' N and 170° 53' E. On examining these microscopically, Professor Bailey found, as Ehrenberg had done in the case of mud obtained on the opposite side of the Arctic region, that the fine mud was made up of shells of *Diatomaceæ,* of spicula of sponges, and of *Radiolaria,* with a small admixture of mineral matters, but without a trace of any calcareous organisms.

Still more complete information has been obtained concerning the nature of the sea bottom in the cold zone around the south pole. Between the years 1839 and 1843, Sir James Clark Ross executed his famous Antarctic expedition, in the course of which he penetrated, at two widely distant points of the Antarctic zone, into the high latitudes of the shores of Victoria Land and of Graham's Land, and reached the parallel of 80° S. Sir James Ross was himself a naturalist of no mean acquirements, and Dr. Hooker,[3] the present President of the Royal Society, accompanied him as naturalist to the expedition, so that the observations upon the fauna and flora of the Antarctic regions made during this cruise were sure to have a peculiar value and importance, even had not the [73] attention of the voyagers been particularly directed to the importance of noting the occurrence of the minutest forms of animal and vegetable life in the ocean.

Among the scientific instructions for the voyage drawn up by a committee of the Royal Society, however, there is a remarkable letter from Von Humboldt to Lord Minto, then First Lord of the Admiralty, in which, among other things, he dwells upon the significance of the researches into the microscopic composition of rocks, and the discovery of the great share which microscopic organisms take in the formation of the crust of the earth at the present day, made by Ehrenberg in the years 1836-39. Ehrenberg, in fact, had shown that the extensive beds of "rotten-stone" or "Tripoli" which occur in various parts of the world, and notably at Bilin in Bohemia, consisted of accumulations of the silicious cases and skeletons of *Diatomaceæ,* sponges, and *Radiolaria;* he had proved that similar deposits were being formed by *Diatomaceæ,* in the pools of the Thiergarten in Berlin and elsewhere, and had pointed out that, if it were commercially worth while, rotten-stone might be manufactured by a process of diatom-culture. Observations conducted at Cuxhaven in 1839, had revealed the existence, at the surface of the waters of the Baltic, of living Diatoms and *Radiolaria* of the same species as those which, in [74] a fossil state, constitute extensive rocks of tertiary age at Caltanisetta, Zante, and Oran, on the shores of the Mediterranean.

Moreover, in the fresh-water rotten-stone beds of Bilin, Ehrenberg had traced out the metamorphosis, effected apparently by the action of percolating water, of the primitively loose and friable deposit of organized particles, in which the silex exists in the hydrated or soluble condition. The silex, in fact, undergoes solution and slow redeposition, until, in ultimate result, the excessively fine-grained sand,

each particle of which is a skeleton, becomes converted into a dense Saline stone, with only here and there an indication of an organism.

From the consideration of these facts, Ehrenberg, as early as the year 1839, had arrived at the conclusion that rocks, altogether similar to those which constitute a large part of the crust of the earth, must be forming, at the present day, at the bottom of the sea; and he threw out the suggestion that even where no trace of organic structure is to be found in the older rocks, it may have been lost by metamorphosis.[4]

[75] The results of the Antarctic exploration, as stated by Dr. Hooker in the "Botany of the Antarctic Voyage," and in a paper which he read before the British Association in 1847, are of the greatest importance in connection with these views, and they are so clearly stated in the former work, which is somewhat inaccessible, that I make no apology for quoting them at length–

"The waters and the ice of the South Polar Ocean were alike found to abound with microscopic vegetables belonging to the order *Diatomaceæ*. Though much too small to be discernible by the naked eye, they occurred in such countless myriads as to stain the berg and the pack ice wherever they were washed by the swell of the sea; and, when enclosed in the congealing surface of the water, they imparted to the brash and pancake ice a pale ochreous colour. In the open ocean, northward of the frozen zone this order, though no doubt almost universally present, generally eludes the search of the naturalist; except when its species are congregated amongst that mucous scum which is sometimes seen floating on the waves, and of whose real nature we are ignorant; or when the coloured contents of the marine animals who feed on these Algæ are examined. To the south, however, of the belt of ice which encircles the globe, between the parallels of 50° and 70° S., and in the waters comprised between that belt and the highest latitude ever attained by man, this vegetation is very conspicuous, from the contrast between its colour and the white snow and ice in which it is imbedded. Insomuch, that in the eightieth degree, all the sulfate ice carried along by the currents, the sides of every berg, and the base of the great Victoria Barrier itself, within reach of the swell, were tinged brown, as if the polar waters were charged with oxide of iron.

"As the majority of these plants consist of very simple vegetable cells, enclosed in indestructible silex (as other Algæ are in carbonate of lime), it is obvious that the death and decomposi[76]tion of such multitudes must form sedimentary deposits, proportionate in their extent to the length and exposure of the coast against which they are washed, in thickness to the power of such agents as the winds, currents, and sea, which sweep them more energetically to certain positions, and in purity, to the depth of the water and nature of the bottom. Hence we detected their remains along every icebound shore, in the depths of the adjacent ocean, between 80 and 400 fathoms. Off Victoria Barrier (a perpendicular wall of ice between one and two hundred feet above the level of the sea) the bottom of the ocean was covered with a stratum of pure white or green mud, composed principally of the silicious shells of the *Diatomaceæ*. These, on being put into water, rendered it cloudy like milk, and took many hours to subside. In the very deep water off Victoria and Graham's Land, this mud was particularly pure and fine; but towards the shallow shores there existed a greater or less admixture of disintegrated rock and sand; so that the organic compounds of the bottom frequently bore but a small proportion to the inorganic." . . .

"The universal existence of such an invisible vegetation as that of the Antarctic Ocean, is a truly wonderful fact, and the more from its not being accompanied by plants of a high order. During the years we spent there, I had been accustomed to regard the phenomena of life as differing totally from what obtains throughout all other latitudes, for everything living appeared to be of animal origin. The ocean swarmed with *Mollusca*, and

particularly entomostracous *Crustacea,* small whales, and porpoises; the sea abounded with penguins and seals, and the air with birds; the animal kingdom was ever present, the larger creatures preying on the smaller and these again on smaller still; all seemed carnivorous. The herbivorous were not recognised, because feeding on a microscopic herbage, of whose true nature I had formed an erroneous impression. It is, therefore with no little satisfaction that I now class the *Diatomaceæ* with plants, probably maintaining in the south Polar Ocean that balance between the vegetable and the animal kingdom which prevails over the surface of our globe. Nor is the sustenance and nutrition of the animal kingdom the only function these [77] minute productions may perform; they may also be the purifiers of the vitiated atmosphere, and thus execute in the Antarctic latitudes the office of our trees and grass turf in the temperate regions, and the broad leaves of the palm, &c., in the tropics." . . .

With respect to the distribution of the *Diatomaceæ,* Dr. Hooker remarks:–

"There is probably no latitude between that of Spitzbergen and Victoria Land, where some of the species of either country do not exist: Iceland, Britain, the Mediterranean Sea, North and South America, and the South Sea Islands, all possess Antarctic *Diatomaceæ* . The silicious coats of species only known living in the waters of the South Polar Ocean, have, during past ages, contributed to the formation of rocks; and thus they outlive several successive creations of organized beings. The phonolite stones of the Rhine, and the Tripoli stone, contain species identical with what are now contributing to form a sedimentary deposit (and perhaps, at some future period, a bed of rock) extending in one continuous stratum for 400 measured miles. I allude to the shores of the Victoria Barrier, along whose coast the soundings examined were invariably charged with diatomaceous remains, constituting a bank which stretches 200 miles north from the base of Victoria Barrier, while the average depth of water above it is 300 fathoms, or 1,800 feet. Again, some of the Antarctic species have been detected floating in the atmosphere which overhangs the wide ocean between Africa and America. The knowledge of this marvellous fact we owe to Mr. Darwin, who, when he was at sea off the Cape de Verd Islands, collected an impalpable powder which fell on Captain Fitzroy's ship. He transmitted this dust to Ehrenberg, who ascertained it to consist of the silicious coats, chiefly of American *Diatomaceæ,* which were being wafted through the upper region of the air, when some meteorological phenomena checked them in their course and deposited them on the ship and surface of the ocean.

"The existence of the remains of many species of this order [78] (and amongst them some Antarctic ones) in the volcanic ashes, pumice, and scoriæ of active and extinct volcanoes (those of the Mediterranean Sea and Ascension Island, for instance) is a fact beating immediately upon the present subject. Mount Erebus, a volcano 12,400 feet high, of the first class in dimensions and energetic action, rises at once from the ocean in the seventy-eighth degree of south latitude, and abreast of the *Diatomaceæ* bank, which reposes in part on its base. Hence it may not appear preposterous to conclude that, as Vesuvius receives the waters of the Mediterranean, with its fish, to eject them by its crater, so the subterranean and subaqueous forces which maintain Mount Erebus in activity may occasionally receive organic matter from the bank, and disgorge it, together with those volcanic products, ashes and pumice.

"Along the shores of Graham's Land and the South Shetland Islands, we have a parallel combination of igneous and aqueous action, accompanied with an equally copious supply of *Diatomaceæ* . In the Gulf of Erebus and Terror, fifteen degrees north of Victoria Land, and placed on the opposite side of the globe the soundings were of a similar nature with those of the Victoria Land and Barrier, and the sea and ice as full of *Diatomaceæ* .This was not only proved by the deep sea lead, but by the examination of bergs which, once stranded, had floated off and become reversed, exposing an accumulation of white friable mud frozen to their bases, which abounded with these vegetable remains."

The *Challenger* has explored the Antarctic seas in a region intermediate between those examined by Sir James Ross's expedition; and the observations made by Dr. Wyville Thomson and his colleagues in every respect confirm those of Dr. Hooker:–

"On the 11th of February, lat. 60° 52' S., long. 80° 20' E., and March 3, lat. 53° 55' S., long. 108° 35' E., the sounding [79] instrument came up filled with a very fine cream-coloured paste, which scarcely effervesced with acid, and dried into a very light, impalpable, white powder. This, when examined under the microscope, was found to consist almost entirely of the frustules of Diatoms, some of them wonderfully perfect in all the details of their ornament, and many of them broken up. The species of Diatoms entering into this deposit have not yet been worked up, but they appear to be referable chiefly to the genera *Fragillaria, Cuscinodiscus, Chætoceros, Asteromphalus,* and *Dictyocha,* with fragments of the separated rods of a singular silicious organism, with which we were unacquainted, and which made up a large proportion of the finer matter of this deposit. Mixed with the Diatoms there were a few small *Globigerinæ,* some of the tests and spicules of Radiolarians, and some sand particles; but these foreign bodies were in too small proportion to affect the formation as consisting practically of Diatoms alone. On the 4th of February, in lat. 52°, 29' S., long., 71° 36' E., a little to the north of the Heard Islands, the tow-net, dragging a few fathoms below the surface, came up nearly filled with a pale yellow gelatinous mass. This was found to consist entirely of Diatoms of the same species as those found at the bottom. By far the most abundant was the little bundle of silicious rods, fastened together loosely at one end, separating from one another at the other end, and the whole bundle loosely twisted into a spindle. The rods are hollow, and contain the characteristic endochrome of the *Diatomaceæ* . Like the *Globigerina* ooze, then, which it succeeds to the southward in a band apparently of no great width, the materials of this silicious deposit are derived entirely from the surface and intermediate depths. It is somewhat singular that Diatoms did not appear to be in such large numbers on the surface over the Diatom ooze as they were a little further north. This may perhaps be accounted for by our not having struck their belt of depth with the tow-net; or it is possible that when we found it on the 11th of February the bottom deposit was really shifted a little to the south by the warm current, the excessively fine flocculent *debris* of the Diatoms taking a certain time to sink. The belt of Diatom ooze is certainly a little further to the southward in long. 83° E., in [80] the path of the reflux of the Agulhas current, than in long. 108° E.

"All along the edge of the ice-pack–everywhere, in fact, to the south of the two stations–on the 11th of February on our southward voyage, and on the 3rd of March on our return, we brought up fine sand and grayish mud, with small pebbles of quartz and felspar, and small fragments of mica-slate, chlorite-slate, clay-slate, gneiss, and granite. This deposit, I have no doubt, was derived from the surface like the others, but in this case by the melting of icebergs and the precipitation of foreign matter contained in the ice.

"We never saw any trace of gravel or sand, or any material necessarily derived from land, on an iceberg. Several showed vertical or irregular fissures filled with discoloured ice or snow but, when looked at closely, the discoloration proved usually to be very slight, and the effect at a distance was usually due to the foreign material filling the fissure reflecting light less perfectly than the general surface of the berg. I conceive that the upper surface of one of these great tabular southern icebergs, including by far the greater part of its bulk, and culminating in the portion exposed above the surface of the sea, was formed by the piling up of successive layers of snow during the period, amounting perhaps to several centuries, during which the ice-cap was slowly forcing itself over the low land and out to sea over a long extent of gentle slope, until it reached a depth considerably above 200 fathoms, when the lower specific weight of the ice caused an upward strain which at length overcame the cohesion of the mass, and portions were rent off and floated away. If this be the true history of the formation of these icebergs, the absence of all land debris in the portion exposed above the surface of the sea is readily

understood. If any such exist, it must be confined to the lower part of the berg, to that part which has at one time or other moved on the floor of the ice-cap.

"The icebergs, when they are first dispersed, float in from 200 to 250 fathoms. When, therefore, they have been drifted to latitudes of 65° or 64° S., the bottom of the berg just reaches the layer at which the temperature of the water is distinctly [81] rising, and it is rapidly melted, and the mud and pebbles with which it is more or less charged are precipitated. That this precipitation takes place all over the area where the icebergs are breaking up, constantly, and to a considerable extent, is evident from the fact of the soundings being entirely composed of such deposits; for the Diatoms, *Globigerinæ,* and radiolarians are present on the surface in large numbers; and unless the deposit from the ice were abundant it would soon be covered and masked by a layer of the exuvia of surface organisms."

The observations which have been detailed leave no doubt that the Antarctic sea bottom from a little to the south of the fiftieth parallel, as far as 80° S., is being covered by a fine deposit of silicious mud, more or less mixed, in some parts, with the ice-borne *débris* of polar lands and with the ejections of volcanoes. The silicious particles which constitute this mud, are derived, in part, from the diatomaceous plants and radiolarian animals which throng the surface, and, in part, from the spicula of sponges which live at the bottom. The evidence respecting the corresponding Arctic area is less complete, but it is sufficient to justify the conclusion that an essentially similar silicious cap is being formed around the northern pole.

There is no doubt that the constituent particles of this mud may agglomerate into a dense rock, such as that formed at Oran, on the shores of the Mediterranean, which is made up of similar materials. Moreover, in the case of freshwater deposits of this kind, it is certain that the action [82] of percolating water may convert the originally soft and friable, fine-grained sandstone into a dense, semi-transparent opaline stone, the silicious organized skeletons being dissolved, and the silex re-deposited in an amorphous state. Whether such a metamorphosis as this occurs in submarine deposits, as well as in those formed in fresh water, does not appear; but there seems no reason to doubt that it may. And hence it may not be hazardous to conclude that very ordinary metamorphic agencies may convert these polar caps into a form of quartzite.

In the great intermediate zone, occupying some 110° of latitude, which separates the circumpolar Arctic and Antarctic areas of silicious deposit, the Diatoms and *Radiolaria* of the surface water and the sponges of the bottom do not die out, and, so far as some forms are concerned, do not even appear to diminish in total number; though, on a rough estimate, it would appear that the proportion of *Radiolaria* to Diatoms is much greater than in the colder seas. Nevertheless the composition of the deep-sea mud of this intermediate zone is entirely different from that of the circumpolar regions.

The first exact information respecting the nature of this mud at depths greater than 1,000 fathoms was given by Ehrenberg, in the account which he published in the "Monatsberichte" of [83] the Berlin Academy for the year 1853, of the soundings obtained by Lieut. Berryman, of the United States Navy, in the North Atlantic, between Newfoundland and the Azores.

Observations which confirm those of Ehrenberg in all essential respects have been made by Professor Bailey, myself, Dr. Wallich, Dr. Carpenter, and Professor Wyville Thomson, in their earlier cruises; and the continuation of the *Globigerina* ooze over the South Pacific has been proved by the recent work of the *Challenger*, by which it is also shown, for the first time, that, in passing from the equator to high southern latitudes, the number and variety of the *Foraminifera* diminishes, and even the *Globigerinæ* become dwarfed. And this result, it will be observed, is in entire accordance with the fact already mentioned that, in the sea of Kamschatka, the deep-sea mud was found by Bailey to contain no calcareous organisms.

Thus, in the whole of the "intermediate zone," the silicious deposit which is being formed there, as elsewhere, by the accumulation of sponge-spicula, *Radiolaria*, and Diatoms, is obscured and overpowered by the immensely greater amount of calcareous sediment, which arises from the aggregation of the skeletons of dead *Foraminifera* . The similarity of the deposit, thus composed of a large percentage of carbonate of lime, and a small percentage of silex, to chalk, regarded merely as a [84] kind of rock, which was first pointed out by Ehrenberg,[5] is now admitted on all hands; nor can it be reasonably doubted, that ordinary metamorphic agencies are competent to convert the "modern chalk" into hard limestone or even into crystalline marble.

Ehrenberg appears to have taken it for granted that the *Globigerina* and other *Foraminifera* which are found in the deep-sea mud, live at the great depths in which their remains are found; and he supports this opinion by producing evidence that the soft parts of these organisms are preserved, and may be demonstrated by removing the calcareous matter with dilute acids. In 1857, the [85] evidence for and against this conclusion appeared to me to be insufficient to warrant a positive conclusion one way or the other, and I expressed myself in my report to the Admiralty on captain Dayman's soundings in the following terms:–

"When we consider the immense area over which this deposit is spread, the depth at which its formation is going on, and its similarity to chalk, and still more to such rocks as the marls of Caltanisetta, the question, whence are all these organisms derived? becomes one of high scientific interest.

"Three answers have suggested themselves:–

"In accordance with the prevalent view of the limitation of life to comparatively small depths, it is imagined either: 1, that these organisms have drifted into their present position from shallower waters; or 2, that they habitually live at the surface of the ocean, and only fall down into their present position.

"1. I conceive that the first supposition is negatived by the extremely marked zoological peculiarity of the deep-sea fauna.

"Had the *Globigerinæ* been drifted into their present position from shallow water, we should find a very large proportion of the characteristic inhabitants of shallow waters mixed with them, and this would the more certainly be the case, as the large *Globigerinæ*, so abundant in the deep-sea soundings, are, in proportion to their size, more solid and massive than almost any other *Foraminifera*. But the fact is that the proportion of other *Foraminifera* is

exceedingly small, nor have I found as yet, in the deep-sea deposits, any such matters as fragments of molluscous shells, of *Echini*, &c., which abound in shallow waters, and are quite as likely to be drifted as the heavy *Globigerinæ*. Again, the relative proportions of young and fully formed *Globigerinæ* seem inconsistent with the notion that they have travelled far. And it seems difficult to imagine why, had the deposit been accumulated in this way, *Coscinodisci* should so almost entirely represent the *Diatomaceæ*.

"2. The second hypothesis is far more feasible, and is strongly supported by the fact that many *Polycistineæ* [*Radiolar*[86]*ia*] and *Coscinodisci* are well known to live at the surface of the ocean. Mr. Macdonald, Assistant-Surgeon of H.M.S. *Herald*, now in the South-Western Pacific, has lately sent home some very valuable observations on living forms of this kind, met with in the stomachs of oceanic mollusks, and therefore certainly inhabitants of the superficial layer of the ocean. But it is a singular circumstance that only one of the forms figured by Mr. Macdonald is at all like a *Globigerina*, and there are some peculiarities about even this which make me greatly doubt its affinity with that genus. The form, indeed, is not unlike that of a *Globigerina*, but it is provided with long radiating processes, of which I have never seen any trace in *Globigerina*. Did they exist, they might explain what otherwise is a great objection to this view, viz., how is it conceivable that the heavy *Globigerina* should maintain itself at the surface of the water?

"If the organic bodies in the deep-sea soundings have neither been drifted, nor have fallen from above, there remains but one alternative–they must have lived and died where they are.

"Important objections, however, at once suggest themselves to this view. How can animal life be conceived to exist under such conditions of light, temperature, pressure, and aeration as must obtain at these vast depths?

"To this one can only reply that we know for a certainty that even very highly-organized animals do continue to live at a depth of 300 and 400 fathoms, inasmuch as they have been dredged up thence; and that the difference in the amount of light and heat at 400 and at 2,000 fathoms is probably, so to speak, very far less than the difference in complexity of organisation between these animals and the humbler *Protozoa* and *Protophyta* of the deep-sea soundings.

"I confess, though as yet far from regarding it proved that the *Globigerinæ* live at these depths, the balance of probabilities seems to me to incline in that direction. And there is one circumstance which weighs strongly in my mind. It may be taken as a law that any genus of animals which is found far back in time is capable of living under a great variety of circumstances as regards light, temperature, and pressure. Now, the [87] genus *Globigerinæ* is abundantly represented in the cretaceous epoch, and perhaps earlier.

"I abstain, however, at present from drawing any positive conclusions, preferring rather to await the result of more extended observations."[6]

Dr. Wallich, Professor Wyville Thomson, and Dr. Carpenter concluded that the *Globigerinæ* live at the bottom. Dr. Wallich writes in 1862–"By sinking very fine gauze nets to considerable depths, I have repeatedly satisfied myself that *Globigerina* does not occur in the superficial strata of the ocean."[7] Moreover, having obtained certain living star-fish from a depth of 1,260 fathoms, and found their stomachs full of "fresh-looking *Globigerinæ*" and their *débris*–he adduces this fact in support of his belief that the *Globigerinæ* live at the bottom.

On the other hand, Müller, Haeckel, Major Owen, Mr. Gwyn Jeffries, and other observers, found that *Globigerinæ,* with the allied genera *Orbulina* and *Pulvinulina* sometimes occur abundantly at the surface of the sea, the shells of these pelagic forms being not unfrequently provided with the long spines noticed by Macdonald; and in 1865 and 1866, Major Owen more especially insisted on the importance of this fact. The recent work of the *Challenger* fully confirms Major Owen's statement. In the paper recently pub [88]lished in the proceedings of the Royal Society,[8] from which a quotation has already been made, Professor Wyville Thomson says:–

"I had formed and expressed a very strong opinion on the matter. It seemed to me that the evidence was conclusive that the *Foraminifera* which formed the *Globigerina* ooze lived on the bottom, and that the occurrence of individuals on the surface was accidental and exceptional; but after going into the thing carefully, and considering the mass of evidence which has been accumulated by Mr. Murray, I now admit that I was in error and I agree with him that it may be taken as proved that all the materials of such deposits, with the exception, of course, of the remains of animals which we now know to live at the bottom at all depths, which occur in the deposit as foreign bodies, are derived from the surface.

"Mr. Murray has combined with a careful examination of the soundings a constant use of the tow-net, usually at the surface, but also at depths of from ten to one hundred fathoms; and he finds the closest relation to exist between the surface fauna of any particular locality and the deposit which is taking place at the bottom. In all seas, from the equator to the polar ice, the tow-net contains *Globigerinæ* .They are more abundant and of a larger size in warmer seas; several varieties, attaining a large size and presenting marked varietal characters, are found in the intertropical area of the Atlantic. In the latitude of Kerguelen they are less numerous and smaller while further south they are still more dwarfed, and only one variety, the typical *Globigerina bulloides*, is represented. The living *Globigerinæ* from the tow-net are singularly different in appearance from the dead shells we find at the bottom. The shell is clear and transparent, and each of the pores which penetrate it is surrounded by a raised crest, the crest round adjacent pores coalescing into a roughly [89] hexagonal network, so that the pores appear to lie at the bottom of a hexagonal pit. At each angle of this hexagon the crest gives off a delicate flexible calcareous spine, which is sometimes four or five times the diameter of the shell in length. The spines radiate symmetrically from the direction of the centre of each chamber of the shell, and the sheaves of long transparent needles crossing one another in different directions have a very beautiful effect. The smaller inner chambers of the shell are entirely filled with an orange-yellow granular sarcode; and the large terminal chamber usually contains only a small irregular mass, or two or three small masses run together, of the same yellow sarcode stuck against one side, the remainder of the chamber being empty. No definite arrangement and no approach to structure was observed in the sarcode, and no differentiation, with the exception of round bright-yellow oil-globules, very much like those found in some of the radiolarians, which are scattered, apparently irregularly, in the sarcode. We never have been able to detect, in any of the large number of *Globigerinæ* which we have examined, the least trace of pseudopodia, or any extension, in any form, of the sarcode beyond the shell.

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"In specimens taken with the tow-net the spines are very usually absent; but that is probably on account of their extreme tenuity; they are broken off by the slightest touch. In fresh examples from the surface, the dots indicating the origin of the lost spines may almost always be made out with a high power. There are never spines on the *Globigerinæ* from the bottom, even in the shallowest water."

There can now be no doubt, therefore, that *Globigerinæ* live at the top of the sea; but the question may still be raised whether they do not also live at the bottom. In favour of this view, it has been urged that the shells of the *Globigerinæ* of the surface never possess such thick walls as [90] those which are found at the bottom, but I confess that I doubt the accuracy of this statement. Again, the occurrence of minute *Globigerinæ* in all stages of development, at the greatest depths, is brought forward as evidence that they live *in situ.* But considering the extent to which the surface organisms are devoured, without discrimination of young and old, by *Salpæ* and the like, it is not wonderful that shells of all ages should be among the rejectamenta. Nor can the presence of the soft parts of the body in the shells which form the *Globigerina* ooze, and the fact, if it be one, that animals living at the bottom use them as food, be considered as conclusive evidence that the *Globigerinæ* live at the bottom. Such as die at the surface, and even many of those which are swallowed by other animals, may retain much of their protoplasmic matter when they reach the depths at which the temperature sinks to 34° or 32° Fahrenheit, where decomposition must become exceedingly slow.

Another consideration appears to me to be in favour of the view that the *Globigerinæ* and their allies are essentially surface animals. This is the fact brought out by the *Challenger's* work, that they have a southern limit of distribution, which can hardly depend upon anything but the temperature of the surface water. And it is to be remarked that this southern limit occurs at a lower latitude in the Antarctic seas than it does [91] in the North Atlantic. According to Dr. Wallich ("The North Atlantic Sea Bed," p. 157) *Globigerina* is the prevailing form in the deposits between the Farœ Islands and Iceland, and between Iceland and East Greenland–or, in other words, in a region of the sea-bottom which lies altogether north of the parallel of 60° N.; while in the southern seas, the *Globigerinæ* become dwarfed and almost disappear between 50° and 55° S. On the other hand, in the sea of Kamschatka, the *Globigerinæ* have vanished in 56° N., so that the persistence of the *Globigerina* ooze in high latitudes, in the North Atlantic, would seem to depend on the northward curve of the isothermal peculiar to this region; and it is difficult to understand how the formation of *Globigerina* ooze can be affected by this climatal peculiarity unless it be effected by surface animals.

Whatever may be the mode of life of the *Foraminifera,* to which the calcareous element of the deep-sea "chalk" owes its existence, the fact that it is the chief and most widely spread material of the sea-bottom in the intermediate zone, throughout both the Atlantic and Pacific Oceans, and the Indian Ocean, at depths from a few hundred to over two thousand fathoms, is established. But it is not the only extensive deposit which is now taking place. In 1853, Count Pourtalès, an officer of the United States Coast Survey, which has done so much for [92] scientific hydrography, observed, that the mud forming the sea-bottom at depths of one hundred and fifty fathoms, in 31° 32' N., 79° 35' W., off the Coast of Florida, was "a mixture, in about equal proportions, of *Globigerinæ* and black sand, probably greensand, as it makes a green mark when crushed on paper." Professor Bailey, examining these grains microscopically, found that they were casts of the interior cavities of *Foraminifera,* consisting of a mineral known as *Glauconite,* which is a silicate of iron and alumina. In these casts the minutest cavities and finest tubes in the Foraminifer were sometimes reproduced in solid counterparts of the glassy mineral, while the calcareous original had been entirely dissolved away.

Contemporaneously with these observations, the indefatigable Ehrenberg had discovered that the "greensands" of the geologist were largely made up of casts of a similar character, and proved the existence of *Foraminifera* at a very ancient geological epoch, by discovering such casts in a greensand of Lower Silurian age, which occurs near St. Petersburg.

Subsequently, Messrs. Parker and Jones discovered similar casts in process of formation, the original shell not having disappeared, in specimens of the sea-bottom of the Australian seas, brought home by the late Professor Jukes. And the *Challenger* has observed a deposit of a [93] character in the course of the Agulhas current, near the Cape of Good Hope, and in some other localities not yet defined.

It would appear that this infiltration of *Foraminifera* shells with *Glauconite* does not take place at great depths, but rather in what may be termed a sublittoral region, ranging from a hundred to three hundred fathoms. It cannot be ascribed to any local cause, for it takes place, not only over large areas in the Gulf of Mexico and the Coast of Florida, but in the South Atlantic and in the Pacific. But what are the conditions which determine its occurrence, and whence the silex, the iron, and the alumina (with perhaps potash and some other ingredients in small quantity) of which the *Glauconite* is composed, proceed, is a point on which no light has yet been thrown. For the present we must be content with the fact that, in certain areas of the "intermediate zone," greensand is replacing and representing the primitively calcareo-silicious ooze.

The investigation of the deposits which are now being formed in the basin of the Mediterranean, by the late Professor Edward Forbes, by Professor Williamson, and more recently by Dr. Carpenter, and a comparison of the results thus obtained with what is known of the surface fauna, have brought to light the remarkable fact, that while the surface and shallows abound with [94] *Foraminifera* and other calcareous shelled organisms, the indications of life become scanty at depths beyond 500 or 600 fathoms, while almost all traces of it disappear at greater depths, and at 1,000 to 2,000 fathoms the bottom is covered with a fine clay.

Dr. Carpenter has discussed the significance of this remarkable fact, and he is disposed to attribute the absence of life at great depths, partly to the absence of any circulation of the water of the Mediterranean at such depths, and partly to the exhaustion of the oxygen of the water by the organic matter contained in the fine clay, which he conceives to be formed by the finest particles; of the mud brought down by the rivers which flow into the Mediterranean.

However this may be, the explanation thus offered of the presence of the fine mud, and of the absence of organisms which ordinarily live at the bottom, does not account for the absence of the skeletons of the organisms which undoubtedly abound at the surface of the Mediterranean; and it would seem to have no application to the remarkable fact discovered by the *Challenger*, that in the open Atlantic and Pacific Oceans, in the midst of the great intermediate zone, and thousands of miles away from the embouchure of any river, the sea-bottom, at depths approaching to and beyond 3,000 fathoms, no longer consists of *Globigerina* ooze, but of an excessively fine red clay.

[95] Professor Thomson gives the following account of this capital discovery:–

"According to our present experience, the deposit of *Globigerina* ooze is limited to water of a certain depth, the extreme limit of the pure characteristic formation being placed at a depth of somewhere about 2,250 fathoms. Crossing from these shallower regions occupied by the ooze into deeper soundings, we find, universally, that the calcareous formation gradually passes into, and is finally replaced by, an extremely fine pure clay, which occupies, speaking generally, all depths below 2,500 fathoms, and consists almost entirely of a silicate of the red oxide of iron and alumina. The transition is very slow, and extends over several hundred fathoms of increasing depth; the shells gradually lose their sharpness of outline, and assume a kind of 'rotten' look and a brownish colour, and become more and more mixed with a fine amorphous red-brown powder, which increases steadily in proportion until the lime has almost entirely disappeared. This brown matter is in the finest possible state of subdivision, so fine that when, after sifting it to separate any organisms it might contain, we put it into jars to settle, it remained for days in suspension, giving the water very much the appearance and colour of chocolate.

"In indicating the nature of the bottom on the charts, we came, from experience and without any theoretical considerations, to use three terms for soundings in deep water. Two of these, Gl. oz. and r. cl., were very definite, and indicated strongly-marked formations, with apparently but few characters in common; but we frequently got soundings which we could not exactly call *'Globigerina* ooze' or 'red clay,' and before we were fully aware of the nature of these, we were in the habit of indicating them as 'grey ooze' (gr. oz.) We now recognise the 'grey ooze' as an intermediate stage between the *Globigerina* ooze and the red clay; we find that on one side, as it were, of an ideal line, the red clay contains more and more of the material of the calcareous ooze, while on the other, the ooze is mixed with an increasing proportion of 'red clay.'

[96] "Although we have met with the same phenomenon so frequently, that we were at length able to predict the nature of the bottom from the depth of the soundings with absolute certainty for the Atlantic and the Southern Sea, we had, perhaps, the best opportunity of observing it in our first section across the Atlantic, between Teneriffe and St. Thomas. The first four stations on this section, at depths from 1,525 to 2,220 fathoms, show *Globigerina* ooze. From the last of these, which is about 300 miles from Teneriffe, the depth gradually increases to 2,740 fathoms at 500, and 2,950 fathoms at 750 miles from Teneriffe. The bottom in these two soundings might have been called 'grey ooze,' for although its nature has altered entirely from the *Globigerina* ooze, the red clay into which it is rapidly passing still contains a considerable admixture of carbonate of lime.

"The depth goes on increasing to a distance of 1,150 miles from Teneriffe, when it reaches 3,150 fathoms; there the clay is pure and smooth, and contains scarcely a trace of lime. From this great depth the bottom gradually rises, and, with decreasing depth, the grey colour and the calcareous composition of the ooze return. Three soundings in 2,050, 1,900, and 1,950 fathoms on the 'Dolphin Rise' gave highly characteristic examples of the *Globigerina* formation. Passing from the middle plateau of the Atlantic into the western trough, with depths a little over 3,000 fathoms, the red clay returned in all its purity; and our last sounding, in 1,420 fathoms, before reaching Sombrero, restored the *Globigerina* ooze with its peculiar associated fauna.

"This section shows also the wide extension and the vast geological importance of the red clay formation. The total distance from Teneriffe to Sombrero is about 2,700 miles. Proceeding from east to west, we have–

About 80 miles of volcanic mud and sand
" 350 " *Globigerina* ooze,

"	1,050	"	red clay,
"	330	"	*Globigerina* ooze,
"	850	"	red clay,
"	40	"	*Globigerina* ooze,

giving a total of 1,900 miles of red clay to 720 miles of *Globigerina* ooze.

[97] "The nature and origin of this vast deposit of clay is a question of the very greatest interest; and although I think there can be no doubt that it is in the main solved, yet some matters of detail are still involved in difficulty. My first impression was that it might be the most minutely divided material, the ultimate sediment produced by the disintegration of the land by rivers and by the action of the sea on exposed coasts, and held in suspension and distributed by ocean currents, and only making itself manifest in places unoccupied by the *Globigerina* ooze. Several circumstances seemed, however, to negative this mode of origin. The formation seemed too uniform; wherever we met with it, it had the same character, and it only varied in composition in containing less or more carbonate of lime.

"Again, we were gradually becoming more and more convinced that all the important elements of the *Globigerina* ooze lived on the surface, and it seemed evident that, so long as the condition on the surface remained the same, no alteration of contour at the bottom could possibly prevent its accumulation; and the surface conditions in the Mid-Atlantic were very uniform, a moderate current of a very equal temperature passing continuously over elevations and depressions, and everywhere yielding to the tow-net the ooze-forming *Foraminifera* in the same proportion. The Mid-Atlantic swarms with pelagic *Mollusca,* and, in moderate depths, the shells of these are constantly mixed with the *Globigerina* ooze, sometimes in number sufficient to make up a considerable portion of its bulk. It is clear that these shells must fall in equal numbers upon the red clay, but scarcely a trace of one of them is ever brought up by the dredge on the red clay area. It might be possible to explain the absence of shell-secreting animals living on the bottom, on the supposition that the nature of the deposit was injurious to them; but then the idea of a current sufficiently strong to sweep them away is negatived by the extreme fineness of the sediment which is being laid down; the absence of surface shells appears to be intelligible only on the supposition that they are in some way removed.

"We conclude, therefore, that the 'red clay' is not an additional substance introduced from without, and occupying certain [98] depressed regions on account of some law regulating its deposition, but that it is produced by the removal, by some means or other, over these areas, of the carbonate of lime, which forms probably about 98 per cent. of the material of the *Globigerina* ooze. We can trace, indeed, every successive stage in the removal of the carbonate of lime in descending the slope of the ridge or plateau where the *Globigerina* ooze is forming, to the region of the clay. We find, first, that the shells of pteropods and other surface *Mollusca* which are constantly falling on the bottom, are absent, or, if a few remain, they are brittle and yellow, and evidently decaying rapidly. These shells of *Mollusca* decompose more easily and disappear sooner than the smaller, and apparently more delicate, shells of rhizopods. The smaller *Foraminifera* now give way, and are found in lessening proportion to the larger; the coccoliths first lose their thin outer border and then disappear; and the clubs of the rhabdoliths get worn out of shape, and are last seen, under a high power, as infinitely minute cylinders scattered over the field. The larger *Foraminifera* are attacked, and instead of being vividly white and delicately sculptured, they become brown and worn, and finally they break up, each according to its fashion; the chamber-walls of *Globigerina* fall into wedge-shaped pieces, which quickly disappear, and a thick rough crust breaks away from the surface of *Orbulina,* leaving a thin inner sphere, at first beautifully transparent, but soon becoming opaque and crumbling

away.

"In the meantime the proportion of the amorphous 'red clay' to the calcareous elements of all kinds increases, until the latter disappear, with the exception of a few scattered shells of the larger *Foraminifera*, which are still found even in the most characteristic samples of the 'red clay.'

"There seems to be no room left for doubt that the red clay is essentially the insoluble residue, the *ash*, as it were, of the calcareous organisms which form the *Globigerina* ooze, after the calcareous matter has been by some means removed. An ordinary mixture of calcareous *Foraminifera* with the shells of pteropods, forming a fair sample of *Globigerina* ooze from near St. Thomas, was carefully washed, and subjected by Mr. [99] Buchanan to the action of weak acid; and he found that there remained after the carbonate of lime had been removed, about 1 per cent. of a reddish mud, consisting of silica, alumina, and the red oxide of iron. This experiment has been frequently repeated with different samples of *Globigerina* ooze, and always with the result that a small proportion of a red sediment remains, which possesses all the characters of the red clay."

* * * * *

"It seems evident from the observations here recorded, that *clay*, which we have hitherto looked upon as essentially the product of the disintegration of older rocks, may be, under certain circumstances, an organic formation like chalk; that, as a matter of fact, an area on the surface of the globe, which we have shown to be of vast extent, although we are still far from having ascertained its limits, is being covered by such a deposit at the present day.

"It is impossible to avoid associating such a formation with the fine, smooth, homogeneous clays and schists, poor in fossils, but showing worm-tubes and tracks, and bunches of doubtful branching things, such as Oldhamia, silicious sponges, and thin-shelled peculiar shrimps. Such formations, more or less metamorphosed, are very familiar, especially to the student of palæozoic geology, and they often attain a vast thickness. One is inclined, from the great resemblance between them in composition and in the general character of the included fauna, to suspect that these may be organic formations, like the modern red clay of the Atlantic and Southern Sea, accumulations of the insoluble ashes of shelled creatures.

"The dredging in the red clay on the 13th of March was unusually rich. The bag contained examples, those with calcareous shells rather stunted, of most of the characteristic deep-water groups of the Southern Sea, including *Umbellularia, Euplectella, Pterocrinus, Brisinga, Ophioglypha, Pourtalesia,* and one or two *Mollusca.* This is, however, very rarely the case. Generally the red clay is barren, or contains only a very small number of forms.

It must be admitted that it is very difficult, at [100] present, to frame any satisfactory explanation of the mode of origin of this singular deposit of red clay.

I cannot say that the theory put forward tentatively, and with much reservation by Professor Thomson, that the calcareous matter is dissolved out by the relatively fresh water of the deep currents from the Antarctic regions, appears satisfactory to me. Nor do I see my way to the acceptance of the suggestion of Dr. Carpenter, that the red clay is the result of the decomposition of previously-formed greensand. At present there is no evidence that greensand casts are ever formed at great depths; nor has it been proved

that *Glauconite* is decomposable by the agency of water and carbonic acid.

I think it probable that we shall have to wait some time for a sufficient explanation of the origin of the abyssal red clay, no less than for that of the sublittoral greensand in the intermediate zone. But the importance of the establishment of the fact that these various deposits are being formed in the ocean, at the present day, remains the same, whether its *rationale* be understood or not.

For, suppose the globe to be evenly covered with sea, to a depth say of a thousand fathoms–then, whatever might be the mineral matter composing the sea-bottom, little or no deposit would be formed upon it, the abrading and denuding action of water, at such a depth, being exceedingly slight. [101] Next, imagine sponges, *Radiolaria, Foraminifera,* and diatomaceous plants, such as those which now exist in the deep-sea, to be introduced: they would be distributed according to the same laws as at present, the sponges (and possibly some of the *Foraminifera*) covering the bottom, while other *Foraminifera,* with the *Radiolaria* and *Diatomaceæ,* would increase and multiply in the surface waters. In accordance with the existing state of things, the *Radiolaria* and Diatoms would have a universal distribution, the latter gathering most thickly in the polar regions, while the *Foraminifera* would be largely, if not exclusively, confined to the intermediate zone; and, as a consequence of this distribution, a bed of "chalk" would begin to form in the intermediate zone, while caps of silicious rock would accumulate on the circumpolar regions.

Suppose, further, that a part of the intermediate area were raised to within two or three hundred fathoms of the surface–for anything that we know to the contrary, the change of level might determine the substitution of greensand for the "chalk"; while, on the other hand, if part of the same area were depressed to three thousand fathoms, that change might determine the substitution of a different silicate of alumina and iron–namely, clay–for the "chalk" that would otherwise be formed.

If the *Challenger* hypothesis, that the red clay is the residue left by dissolved *Foraminiferous* [102] skeletons, is correct, then all these deposits alike would be directly, or indirectly, the product of living organisms. But just as a silicious deposit may be metamorphosed into opal or quartzite, and chalk into marble, so known metamorphic agencies may metamorphose clay into schist, clay-slate, slate, gneiss, or even granite. And thus, by the agency of the lowest and simplest of organisms, our imaginary globe might be covered with strata, of all the chief kinds of rock of which the known crust of the earth is composed, of indefinite thickness and extent.

The bearing of the conclusions which are now either established, or highly probable, respecting the origin of silicious, calcareous, and clayey rocks, and their metamorphic derivatives, upon the archæology of the earth, the elucidation of which is the ultimate object of the geologist, is of no small importance.

A hundred years ago the singular insight of Linnæus enabled him to say that "fossils are not the children but the parents of rocks,"[9] and the [103] whole effect of the discoveries made since his time has been to compile a larger and larger commentary upon this text. It is, at present, a perfectly tenable hypothesis

that all silicious and calcareous rocks are either directly, or indirectly, derived from material which has, at one time or other, formed part of the organized framework of living organisms. Whether the same generalization may be extended to aluminous rocks, depends upon the conclusion to be drawn from the facts respecting the red clay areas brought to light by the *Challenger*. If we accept the view taken by Wyville Thomson and his colleagues–that the red clay is the residuum left after the calcareous matter of the *Globigerinæ* ooze has been dissolved away–then clay is as much a product of life as limestone, and all known derivatives of clay may have formed part of animal bodies.

So long as the *Globigerinæ*, actually collected at the surface, have not been demonstrated to contain the elements of clay, the *Challenger* hypothesis, as I may term it, must be accepted with reserve and provisionally, but, at present, I cannot but think that it is more probable than any other suggestion which has been made.

Accepting it provisionally, we arrive at the remarkable result that all the chief known constituents of the crust of the earth may have formed part of living bodies; that they may be the "ash" of protoplasm; that the "*rupes saxei*" [104] are not only "*temporis*," but "*vitæ filiæ*"; and, consequently, that the time during which life has been active on the globe may be indefinitely greater than the period, the commencement of which is marked by the oldest known rocks, whether fossiliferous or unfossiliferous.

And thus we are led to see where the solution of a great problem and apparent paradox of geology may lie. Satisfactory evidence now exists that some animals in the existing world have been derived by a process of gradual modification from pre-existing forms. It is undeniable, for example, that the evidence in favour of the derivation of the horse from the later tertiary *Hipparion*, and that of the *Hipparion* from *Anchitherium*, is as complete and cogent as such evidence can reasonably be expected to be; and the further investigations into the history of the tertiary mammalia are pushed, the greater is the accumulation of evidence having the same tendency. So far from palæontology lending no support to the doctrine of evolution–as one sees constantly asserted–that doctrine, if it had no other support, would have been irresistibly forced upon us by the palæontological discoveries of the last twenty years.

If, however, the diverse forms of life which now exist have been produced by the modification of previously-existing less divergent forms, the recent and extinct species, taken as a whole, must fall into series which must converge as we go back in [105] time. Hence, if the period represented by the rocks is greater than, or co-extensive with, that during which life has existed, we ought, somewhere among the ancient formations, to arrive at the point to which all these series converge, or from which, in other words, they have diverged–the primitive undifferentiated protoplasmic living things, whence the two great series of plants and animals have taken their departure.

But, as a matter of fact, the amount of convergence of series, in relation to the time occupied by the deposition of geological formations, is extraordinarily small. Of all animals the higher *Vertebrata* are the most complex; and among these the carnivores and hoofed animals (*Ungulata*) are highly differentiated. Nevertheless, although the different lines of modification of the *Carnivora* and those of the *Ungulata*, respectively, approach one another, and, although each group is represented by less differentiated forms

in the older tertiary rocks than at the present day, the oldest tertiary rocks do not bring us near the primitive form of either. If, in the same way, the convergence of the varied forms of reptiles is measured against the time during which their remains are preserved–which is represented by the whole of the tertiary and Mesozoic formations–the amount of that convergence is far smaller than that of the lines of mammals, between the present time and the beginning of the tertiary epoch. And it is a [106] broad fact that, the lower we go in the scale of organization, the fewer signs are there of convergence towards the primitive form from whence all must have diverged, if evolution be a fact. Nevertheless, that it is a fact in some cases, is proved, and I, for one, have not the courage to suppose that the mode in which some species have taken their origin is different from that in which the rest have originated.

What, then, has become of all the marine animals which, on the hypothesis of evolution, must have existed in myriads in those seas, wherein the many thousand feet of Cambrian and Laurentian rocks now devoid, or almost devoid, of any trace of life were deposited?

Sir Charles Lyell long ago suggested that the azoic character of these ancient formations might be due to the fact that they had undergone extensive metamorphosis; and readers of the "Principles of Geology" will be familiar with the ingenious manner in which he contrasts the theory of the Gnome, who is acquainted only with the interior of the earth, with those of ordinary philosophers, who know only its exterior.

The metamorphism contemplated by the great modern champion of rational geology is, mainly, that brought about by the exposure of rocks to subterranean heat; and where no such heat could be shown to have operated, his opponents assumed that no metamorphosis could have taken [107] place. But the formation of greensand, and still more that of the "red clay" (if the *Challenger* hypothesis be correct) affords an insight into a new kind of metamorphosis–not igneous, but aqueous–by which the primitive nature of a deposit may be masked as completely as it can be by the agency of heat. And, as Wyville Thomson suggests, in the passage I have quoted above (p. 17), it further enables us to assign a new cause for the occurrence, so puzzling hitherto, of thousands of feet of unfossiliferous fine-grained schists and slates, in the midst of formations deposited in seas which certainly abounded in life. If the great deposit of "red clay" now forming in the eastern valley of the Atlantic were metamorphosed into slate and then upheaved, it would constitute an "azoic" rock of enormous extent. And yet that rock is now forming in the midst of a sea which swarms with living beings, the great majority of which are provided with calcareous or silicious shells and skeletons; and, therefore, are such as, up to this time, we should have termed eminently preservable.

Thus the discoveries made by the *Challenger* expedition, like all recent advances in our knowledge of the phenomena of biology, or of the changes now being effected in the structure of the surface of the earth, are in accordance with, and lend strong support to, that doctrine of Uniformitarianism, which, fifty [108] years ago, was held only by a small minority of English geologists–Lyell, Scrope, and De la Beche–but now, thanks to the long-continued labours of the first two, and mainly to those of Sir Charles Lyell, has gradually passed from the position of a heresy to that of catholic doctrine.

Applied within the limits of the time registered by the known fraction of the crust of the earth, I believe that uniformitarianism is unassailable. The evidence that, in the enormous lapse of time between the deposition of the lowest Laurentian strata and the present day, the forces which have modified the surface of the crust of the earth were different in kind, or greater in the intensity of their action, than those which are now occupied in the same work, has yet to be produced. Such evidence as we possess all tends in the contrary direction, and is in favour of the same slow and gradual changes occurring then as now.

But this conclusion in nowise conflicts with the deductions of the physicist from his no less clear and certain data. It may be certain that this globe has cooled down from a condition in which life could not have existed; it may be certain that, in so cooling, its contracting crust must have undergone sudden convulsions, which were to our earthquakes as an earthquake is to the vibration caused by the periodical eruption of a Geyser; but in that case, the earth must, like other respectable parents, have sowed her wild oats, and got through [109] her turbulent youth, before we, her children, have any knowledge of her.

So far as the evidence afforded by the superficial crust of the earth goes, the modern geologist can, *ex animo,* repeat the saying of Hutton, "We find no vestige of a beginning–no prospect of an end." However, he will add, with Hutton, "But in thus tracing back the natural operations which have succeeded each other, and mark to us the course of time past, we come to a period in which we cannot see any further." And if he seek to peer into the darkness of this period, he will welcome the light proffered by physics and mathematics.

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[1] See the preceding Essay.

[2] *Ueber neue Anschauungen des kleinsten nördlichen Polarlebens*–Monatsberichte d. K. Akad. Berlin, 1853.

[3] [Now Sir Joseph Hooker. 1894]

[4] *Ueber die noch jetzt zahlreich lebende Thierarten der Kreidebildung und den Organismus der Polythalamien. Abhandlungen der Kön. Akad. der Wissenchaften,* 1839. Berlin. 1841. I am afraid that this remarkable paper has been somewhat overlooked in the recent discussions of the relation of ancient rocks to modern deposits.

[5] The following passages in Ehrenberg's memoir on *The Organisms in the Chalk which are still living* (1839) are conclusive:–

"7. The dawning period of the existing living organic creation, if such a period is distinguishable (which is doubtful), can only be supposed to have existed on the other side of, and below, the chalk formation; and thus, either the chalk, with its widespread and thick beds, must enter into the series of newer formations; or some of the accepted four great geological periods, the quaternary, tertiary, and secondary formations, contain organisms which still live. It is more probable, in the proportion of 3 to 1, that the transition or primary period is not different, but that it is only more difficult to examine and understand by reason of the gradual and prolonged

chemical decomposition and metamorphosis of many of its organic constituents."

"10. By the mass-forming *Infusoria* and *Polythalamia,* secondary are not distinguishable from tertiary formations; and, from what has been said, it is possible that, at this very day, rock masses are forming in the sea, and being raised by volcanic agencies, the constitution of which, on the whole, is altogether similar to that of the chalk. The chalk remains distinguishable by its organic remains as a formation, but not as a kind of rock."

[6] Appendix to Report on Deep-sea Soundings in the Atlantic Ocean by Lieut. Commander Joseph Dayman. 1857.

[7] The *North Atlantic Sea-bed,* p. 137.

[8] "Preliminary Notes ore the Nature of the Sea-bottom procured by the soundings of H.M.S. *Challenger* during her cruise in the Southern Seas, in the early part of the year 1874,"–*Proceedings of the Royal Society,* Nov. 26, 1874.

[9] "Petrificata montium calcariorum non filii sed parentes sunt, cum omnis calx oriatur ab animalibus. "–*Systema Naturæ,* Ed. xii. t. iii., p. 154. It must be recollected that Linnæus included silex, as well as limestone, under the name of "calx," and that he would probably have arranged Diatoms among animals, as part of "chaos." Ehrenberg quotes another even more pithy passage, which I have not been able to find in any edition of the *Systema* accessible to me: "Sic lapides ab animalibus, nec vice versa. Sic runes saxei non primævi, sed temporis filiæ."

THE HUXLEY FILE

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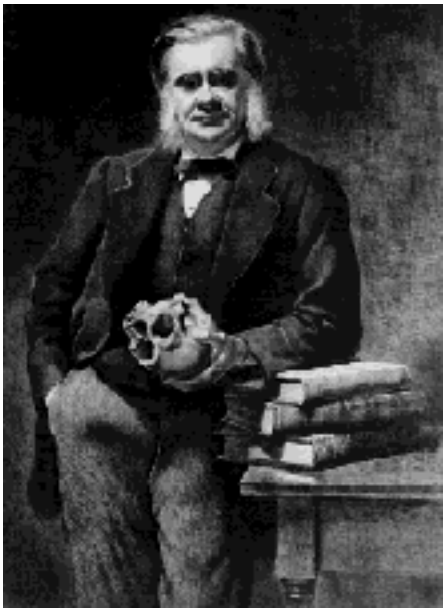

Geological Contemporaneity and Persistent Types of Life

Quarterly Journal of the Geological Society (1862)

Collected Essays VIII

[272] Merchants occasionally go through a wholesome, though troublesome and not always satisfactory, process which they term "taking stock." After all the excitement of speculation, the pleasure of gain, and the pain of loss, the trader makes up his mind to face facts and to learn the exact quantity and quality of his solid and reliable possessions.

The man of science does well sometimes to imitate this procedure; and, forgetting for the time the importance of his own small winnings, to re-examine the common stock in trade, so that he may make sure how far the stock of bullion in the cellar–on the faith of whose existence so much paper has been circulating–is really the solid gold of truth.

The Anniversary Meeting of the Geological [273] Society seems to be an occasion well suited for an undertaking of this kind–for an inquiry, in fact, into the nature and value of the present results of palæontological investigation; and the more so, as all those who have paid close attention to the late multitudinous discussions in which palæontology is implicated, must have felt the urgent necessity of some such scrutiny.

First in order, as the most definite and unquestionable of all the results of palæontology, must be mentioned the immense extension and impulse given to botany, zoology, and comparative anatomy, by the investigation of fossil remains. Indeed, the mass of biological facts has been so greatly increased, and the range of biological speculation has been so vastly widened, by the researches of the geologist and palæontologist, that it is to be feared there are naturalists in existence who look upon geology as Brindley regarded rivers. "Rivers," said the great engineer, "were made to feed canals;" and geology, some seem to think, was solely created to advance comparative anatomy.

Were such a thought justifiable, it could hardly expect to be received with favour by this assembly. But it is not justifiable. Your favourite science has her own great aims independent of all others; and if, notwithstanding her steady devotion to her own progress, she can scatter such rich alms among her sisters, it should be remembered [274] that her charity is of the sort that does not impoverish, but "blesseth him that gives and him that takes."

Regard the matter as we will, however, the facts remain. Nearly 40,000 species of animals and plants have been added to the Systema Naturæ by palæontological research. This is a living population equivalent to that of a new continent in mere number; equivalent to that of a new hemisphere, if we take into account the small population of insects as yet found fossil, and the large proportion and peculiar organisation of many of the Vertebrata.

But, beyond this, it is perhaps not too much to say that, except for the necessity of interpreting palæontological facts, the laws of distribution would have received less careful study; while few comparative anatomists (and those not of the first order) would have been induced by mere love of detail, as such, to study the minutiæ of osteology, were it not that in such minutiæ lie the only keys to the most interesting riddles offered by the extinct animal world.

These assuredly are great and solid gains. Surely it is matter for no small congratulation that in half a century (for palæontology, though it dawned earlier, came into full day only with Cuvier) a subordinate branch of biology should have doubled the value and the interest of the whole group of sciences to which it belongs.

[275] But this is not all. Allied with geology, palæontology has established two laws of inestimable importance: the first, that one and the same area of the earth's surface has been successively occupied by very different kinds of living beings; the second, that the order of succession established in one locality holds good, approximately, in all.

The first of these laws is universal and irreversible; the second is an induction from a vast number of observations, though it may possibly, and even probably, have to admit of exceptions. As a consequence of the second law, it follows that a peculiar relation frequently subsists between series of strata containing organic remains, in different localities. The series resemble one another not only in virtue of a general resemblance of the organic remains in the two, but also in virtue of a resemblance in the order and character of the serial succession in each. There is a resemblance of arrangement; so that the separate terms of each series, as well as the whole series, exhibit a correspondence.

Succession implies time; the lower members of an undisturbed series of sedimentary rocks are certainly older than the upper; and when the notion of age was once introduced as the equivalent of succession, it was no wonder that correspondence in succession came to be looked upon as a correspondence in age, or "contemporaneity." And, indeed, so long as relative age only is spoken [276] of, correspondence in succession *is* correspondence in age; it is *relative* contemporaneity.

But it would have been very much better for geology if so loose and ambiguous a word as "contemporaneous" had been excluded from her terminology, and if, in its stead, some term expressing similarity of serial relation, and excluding the notion of time altogether, had been employed to denote correspondence in position in two or more series of strata.

In anatomy, where such correspondence of position has constantly to be spoken of, it is denoted by the word "homology" and its derivatives; and for Geology (which after all is only the anatomy and physiology of the earth) it might be well to invent some single word, such as "homotaxis" (similarity of order), in order to express an essentially similar idea. This, however, has not been done, and most probably the inquiry will at once be made–To what end burden science with a new and strange term in place of one old, familiar, and part of our common language?

The reply to this question will become obvious as the inquiry into the results of palæontology is pushed further.

Those whose business it is to acquaint themselves specially with the works of palæontologists, in fact, will be fully aware that very few, if any, would rest satisfied with such a statement of the conclusions [277] of their branch of biology as that which has just been given.

Our standard repertories of palæontology profess to teach us far higher things–to disclose the entire succession of living forms upon the surface of the globe; to tell us of a wholly different distribution of climatic conditions in ancient times; to reveal the character of the first of all living existences; and to trace out the law of progress from them to us.

It may not be unprofitable to bestow on these professions a somewhat more critical examination than they have hitherto received, in order to ascertain how far they rest on an irrefragable basis; or whether, after all, it might not be well for palæontologists to learn a little more carefully that scientific "ars artium," the art of saying "I don't know." And to this end let us define somewhat more exactly the extent of these pretensions of palæontology.

Every one is aware that Professor Bronn's "Untersuchungen" and Professor Pictet's "Traité de Paléontologie" are works of standard authority, familiarly consulted by every working palæontologist. It is desirable to speak of these excellent books, and of their distinguished authors, with the utmost respect, and in a tone as far as possible removed from carping criticism; indeed, if they are specially cited in this place, it is merely in justification of the assertion that the following proposi[278]tions, which may be found implicitly, or explicitly, in the works in question, are regarded by the mass of palæontologists and geologists, not only on the Continent but in this country, as expressing some of the best-established results of palæontology. Thus:–

Animals and plants began their existence together, not long after the commencement of the deposition of the sedimentary rocks; and then succeeded one another, in such a manner, that totally distinct faunæ and floræ occupied the whole surface of the earth, one after the other, and during distinct epochs of time.

A geological formation is the sum of all the strata deposited over the whole surface of the earth during one of these epochs: a geological fauna or flora is the sum of all the species of animals or plants which occupied the whole surface of the globe, during one of these epochs.

The population of the earth's surface was at first very similar in all parts, and only from the middle of the Tertiary epoch onwards, began to show a distinct distribution in zones.

The constitution of the original population, as well as the numerical proportions of its members, indicates a warmer and, on the whole, somewhat tropical climate, which remained tolerably equable throughout the year. The subsequent distribution of living beings in zones is the result of a gradual [279] lowering of the general temperature, which first began to be felt at the poles.

It is not now proposed to inquire whether these doctrines are true or false; but to direct your attention to a much simpler though very essential preliminary question–What is their logical basis? what are the fundamental assumptions upon which they all logically depend? and what is the evidence on which those fundamental propositions demand our assent?

These assumptions are two: the first, that the commencement of the geological record is coëval with the commencement of life on the globe; the second, that geological contemporaneity is the same thing as chronological synchrony. Without the first of these assumptions there would of course be no ground for any statement respecting the commencement of life; without the second, all the other statements cited, every one of which implies a knowledge of the state of different parts of the earth at one and the same time, will be no less devoid of demonstration.

The first assumption obviously rests entirely on negative evidence. This is, of course, the only evidence that ever can be available to prove the commencement of any series of phenomena; but, at the same time, it must be recollected that the value of negative evidence depends entirely on the amount of positive corroboration it receives. If A.B. [280] wishes to prove an *alibi*, it is of no use for him to get a thousand witnesses simply to swear that they did not see him in such and such a place, unless the witnesses are prepared to prove that they must have seen him had he been there. But the evidence that animal life commenced with the Lingula-flags, *e.g.*, would seem to be exactly of this unsatisfactory uncorroborated sort. The Cambrian witnesses simply swear they "haven't seen anybody their way"; upon which the counsel for the other side immediately puts in ten or twelve thousand feet of Devonian sandstones to make oath they never saw a fish or a mollusk, though all the world knows there were plenty in their time.

But then it is urged that, though the Devonian rocks in one part of the world exhibit no fossils, in another they do, while the lower Cambrian rocks nowhere exhibit fossils, and hence no living being could have existed in their epoch.

To this there are two replies: the first that the observational basis of the assertion that the lowest rocks are nowhere fossiliferous is an amazingly small one, seeing how very small an area, in comparison to that of the whole world, has yet been fully searched; the second, that the argument is good for nothing unless the unfossiliferous rocks in question were not only *contemporaneous* in the geological sense, but *synchronous* in the chronological sense. To use the *alibi* illustration again. [281] If a man wishes to prove he was in neither of two places, A and B, on a given day, his witnesses for each place must be prepared to answer for the whole day. If they can only prove that he was not at A in the morning, and not at B in the afternoon, the evidence of his absence from both is *nil*, because he might have been at B in the morning and at A in the afternoon.

Thus everything depends upon the validity of the second assumption. And we must proceed to inquire what is the real meaning of the word "contemporaneous" as employed by geologists. To this end a concrete example may be taken.

The Lias of England and the Lias of Germany, the Cretaceous rocks of Britain and the Cretaceous rocks of Southern India, are termed by geologists "contemporaneous" formations; but whenever any thoughtful geologist is asked whether he means to say that they were deposited synchronously, he says, "No,–only within the same great epoch." And if, in pursuing the inquiry, he is asked what may be the approximate value in time of a "great epoch"–whether it means a hundred years, or a thousand, or a million, or ten million years–his reply is, "I cannot tell."

If the further question be put, whether physical geology is in possession of any method by which the actual synchrony (or the reverse) of any two distant deposits can be ascertained, no such method can be heard of; it being admitted by all [282] the best authorities that neither similarity of mineral composition, nor of physical character, nor even direct continuity of stratum, are *absolute* proofs of the synchronism of even approximated sedimentary strata: while, for distant deposits, there seems to be no kind of physical evidence attainable of a nature competent to decide whether such deposits were formed simultaneously, or whether they possess any given difference of antiquity. To return to an example already given: All competent authorities will probably assent to the proposition that physical geology does not enable us in any way to reply to this question–Were the British Cretaceous rocks deposited at the same time as those of India, or are they a million of years younger or a million of years older?

Is palæontology able to succeed where physical geology fails? Standard writers on palæontology, as has been seen, assume that she can. They take it for granted, that deposits containing similar organic remains are synchronous–at any rate in a broad sense; and yet, those who will study the eleventh and twelfth chapters of Sir Henry De La Beche's remarkable "Researches in Theoretical Geology," published now nearly thirty years ago, and will carry out the arguments there most luminously stated, to their logical consequences, may very easily convince themselves that even absolute identity of organic [283] contents is no proof of the synchrony of deposits, while absolute diversity is no proof of difference of date. Sir Henry De La Beche goes even further, and adduces conclusive evidence to show that the different parts of one and the same stratum, having a similar composition throughout, containing the same organic remains, and having similar beds above and below it, may yet differ to any conceivable extent in age.

Edward Forbes was in the habit of asserting that the similarity of the organic contents of distant formations was *prima facie* evidence, not of their similarity, but of their difference of age; and holding as he did the doctrine of single specific centres, the conclusion was as legitimate as any other; for the two districts must have been occupied by migration from one of the two, or from an intermediate spot, and the chances against exact coincidence of migration and of imbedding are infinite.

In point of fact, however, whether the hypothesis of single or of multiple specific centres be adopted, similarity of organic contents cannot possibly afford any proof of the synchrony of the deposits which contain them; on the contrary, it is demonstrably compatible with the lapse of the most prodigious intervals of time, and with the interposition of vast changes in the organic and inorganic worlds, between the epochs in which such deposits were formed.

[284] On what amount of similarity of their faunæ is the doctrine of the contemporaneity of the

European and of the North American Silurians based? In the last edition of Sir Charles Lyell's "Elementary Geology" it is stated, on the authority of a former President of this Society, the late Daniel Sharpe, that between 30 and 40 per cent. of the species of Silurian Mollusca are common to both sides of the Atlantic. By way of due allowance for further discovery, let us double the lesser number and suppose that 60 per cent. of the species are common to the North American and the British Silurians. Sixty per cent. of species in common is, then, proof of contemporaneity.

Now suppose that, a million or two of years hence, when Britain has made another dip beneath the sea and has come up again, some geologist applies this doctrine, in comparing the strata laid bare by the upheaval of the bottom, say, of St. George's Channel with what may then remain of the Suffolk Crag. Reasoning in the same way, he will at once decide the Suffolk Crag and the St. George's Channel beds to be contemporaneous; although we happen to know that a vast period (even in the geological sense) of time, and physical changes of almost unprecedented extent, separate the two.

But if it be a demonstrable fact that strata containing more than 60 or 70 per cent. of species [285] of Mollusca in common, and comparatively close together, may yet be separated by an amount of geological time sufficient to allow of some of the greatest physical changes the world has seen, what becomes of that sort of contemporaneity the sole evidence of which is a similarity of facies, or the identity of half a dozen species, or of a good many genera?

And yet there is no better evidence for the contemporaneity assumed by all who adopt the hypothesis of universal faunæ and floræ, of a universally uniform climate, and of a sensible cooling of the globe during geological time.

There seems, then, no escape from the admission that neither physical geology, nor palæontology, possesses any method by which the absolute synchronism of two strata can be demonstrated. All that geology can prove is local order of succession. It is mathematically certain that, in any given vertical linear section of an undisturbed series of sedimentary deposits, the bed which lies lowest is the oldest. In many other vertical linear sections of the same series, of course, corresponding beds will occur in a similar order; but, however great may be the probability, no man can say with absolute certainty that the beds in the two sections were synchronously deposited. For areas of moderate extent, it is doubtless true that no practical evil is likely to result from assuming the corresponding beds to [286] be synchronous or strictly contemporaneous; and there are multitudes of accessory circumstances which may fully justify the assumption of such synchrony. But the moment the geologist has to deal with large areas, or with completely separated deposits, the mischief of confounding that "homotaxis" or "similarity of arrangement," which *can* be demonstrated, with "synchrony" or "identity of date," for which there is not a shadow of proof, under the one common term of "contemporaneity" becomes incalculable, and proves the constant source of gratuitous speculations.

For anything that geology or palæontology are able to show to the contrary, a Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa. Geographical provinces and zones may have been as distinctly

marked in the Palæozoic epoch as at present, and those seemingly sudden appearances of new genera and species, which we ascribe to new creation, may be simple results of migration.

It may be so; it may be otherwise. In the present condition of our knowledge and of our methods, one verdict–"not proven, and not provable"–must be recorded against all the grand hypotheses of the palæontologist respecting the general succession of life on the globe. The [287] order and nature of terrestrial life, as a whole, are open questions. Geology at present provides us with most valuable topographical records, but she has not the means of working them into a universal history. Is such a universal history, then, to be regarded as unattainable? Are all the grandest and most interesting problems which offer themselves to the geological student, essentially insoluble? Is he in the position of a scientific Tantalus–doomed always to thirst for a knowledge which he cannot obtain? The reverse is to be hoped; nay, it may not be impossible to indicate the source whence help will come.

In commencing these remarks, mention was made of the great obligations under which the naturalist lies to the geologist and palæontologist. Assuredly the time will come when these obligations will be repaid tenfold, and when the maze of the world's past history, through which the pure geologist and the pure palæontologist find no guidance, will be securely threaded by the clue furnished by the naturalist.

All who are competent to express an opinion on the subject are, at present, agreed that the manifold varieties of animal and vegetable form have not either come into existence by chance, nor result from capricious exertions of creative power; but that they have taken place in a definite order, the statement of which order is what men of science term a natural law. Whether such a law [288] is to be regarded as an expression of the mode of operation of natural forces, or whether it is simply a statement of the manner in which a supernatural power has thought fit to act, is a secondary question, so long as the existence of the law and the possibility of its discovery by the human intellect are granted. But he must be a half-hearted philosopher who, believing in that possibility, and having watched the gigantic strides of the biological sciences during the last twenty years, doubts that science will sooner or later make this further step, so as to become possessed of the law of evolution of organic forms–of the unvarying order of that great chain of causes and effects of which all organic forms, ancient and modern, are the links. And then, if ever, we shall be able to begin to discuss, with profit, the questions respecting the commencement of life, and the nature of the successive populations of the globe, which so many seem to think are already answered.

The preceding arguments make no particular claim to novelty; indeed they have been floating more or less distinctly before the minds of geologists for the last thirty years; and if, at the present time, it has seemed desirable to give them more definite and systematic expression, it is because palæontology is every day assuming a greater importance, and now requires to rest on a basis [289] the firmness of which is thoroughly well assured. Among its fundamental conceptions, there must be no confusion between what is certain and what is more or less probable.[1] But, pending the construction of a surer foundation than palæontology now possesses, it may be instructive, assuming for the nonce the general correctness of the ordinary hypothesis of geological contemporaneity, to consider whether the deductions which are ordinarily drawn from the whole body of palæontological facts are justifiable.

The evidence on which such conclusions are based is of two kinds, negative and positive. The value of negative evidence, in connection with this inquiry, has been so fully and clearly discussed in an address from the chair of this Society,[2] which none of us have forgotten, that nothing need at present be said about it; the more, as the considerations which have been laid before you have certainly not tended to increase your estimation of such evidence. It will be preferable to turn to the positive facts of palæontology, and to inquire what they tell us.

We are all accustomed to speak of the number and the extent of the changes in the living population of the globe during geological time as [290] something enormous: and indeed they are so, if we regard only the negative differences which separate the older rocks from the more modern, and if we look upon specific and generic changes as great changes, which from one point of view, they truly are. But leaving the negative differences out of consideration, and looking only at the positive data furnished by the fossil world from a broader point of view–from that of the comparative anatomist who has made the study of the greater modifications of animal form his chief business–a surprise of another kind dawns upon the mind; and under *this* aspect the smallness of the total change becomes as astonishing as was its greatness under the other.

There are two hundred known orders of plants; of these not one is certainly known to exist exclusively in the fossil state. The whole lapse of geological time has as yet yielded not a single new ordinal type of vegetable structure.[3]

The positive change in passing from the recent to the ancient animal world is greater, but still singularly small. No fossil animal is so distinct from those now living as to require to be arranged even in a separate class from those which contain existing forms. It is only when we come to the orders, which may be roughly estimated at about a hundred and thirty, that we meet with fossil [291] animals so distinct from those now living as to require orders for themselves; and these do not amount, on the most liberal estimate, to more than about 10 per cent. of the whole.

There is no certainly known extinct order of Protozoa; there is but one among the Cœlenterata–that of the rugose corals; there is none among the Mollusca; there are three, the Cystidea, Blastoidea, and Edrioasterida, among the Echinoderms; and two, the Trilobita and Eurypterida, among the Crustacea; making altogether five for the great sub-kingdom of Annulosa. Among Vertebrates there is no ordinally distinct fossil fish: there is only one extinct order of Amphibia–the Labyrinthodonts; but there are at least four distinct orders of Reptilia, viz. the Ichthyosauria, Plesiosauria, Pterosauria, Dinosauria, and perhaps another or two. There is no known extinct order of Birds, and no certainly known extinct order of Mammals, the ordinal distinctness of the "Toxodontia" being doubtful.

The objection that broad statements of this kind, after all, rest largely on negative evidence is obvious, but it has less force than may at first be supposed; for, as might be expected from the circumstances of the case, we possess more abundant positive evidence regarding Fishes and marine Mollusks than respecting any other forms of animal life; and yet these offer us, through the whole range of geological

time, no species ordinally [292] distinct from those now living; while the far less numerous class of Echinoderms presents three; and the Crustacea two, such orders, though none of these come down later than the Palæozoic age. Lastly, the Reptilia present the extraordinary and exceptional phenomenon of as many extinct as existing orders, if not more; the four mentioned maintaining their existence from the Lias to the Chalk inclusive.

Some years ago one of your Secretaries pointed out another kind of positive palæontological evidence tending towards the same conclusion–afforded by the existence of what he termed "persistent types" of vegetable and of animal life.[4] He stated, on the authority of Dr. Hooker, that there are Carboniferous plants which appear to be generically identical with some now living; that the cone of the Oolitic *Araucaria* is hardly distinguishable from that of an existing species; that a true *Pinus* appears in the Purbecks and a *Juglans* in the Chalk; while, from the Bagshot Sands, a *Banksia*, the wood of which is not distinguishable from that of species now living in Australia, had been obtained.

Turning to the animal kingdom, he affirmed the tabulate corals of the Silurian rocks to be wonderfully like those which now exist; while [293] even the families of the Aporosa were all represented in the older Mesozoic rocks.

Among the Mollusca similar facts were adduced. Let it be borne in mind that *Avicula, Mytilus, Chiton, Natica, Patella, Trochus, Discina, Orbicula, Lingula, Rhynchonella,* and *Nautilus,* all of which are existing *genera,* are given without a doubt as Silurian in the last edition of "Siluria"; while the highest forms of the highest Cephalopods are represented in the Lias by a genus *Belemnoteuthis,* which presents the closest relation to the existing *Loligo.*

The two highest groups of the Annulosa, the Insecta and the Arachnida, are represented in the Coal, either by existing genera, or by forms differing from existing genera in quite minor peculiarities.

Turning to the Vertebrata, the only palæozoic Elasmobranch Fish of which we have any complete knowledge is the Devonian and Carboniferous *Pleuracanthus,* which differs no more from existing Sharks than these do from one another.

Again, vast as is the number of undoubtedly Ganoid fossil Fishes, and great as is their range in time, a large mass of evidence has recently been adduced to show that almost all those respecting which we possess sufficient information, are referable to the same sub-ordinal groups as the existing *Lepidosteus, Polypterus,* and Sturgeon; and that a singular relation obtains between the [294] older and the younger Fishes; the former, the Devonian Ganoids, being almost all members of the same sub-order as *Polypterus,* while the Mesozoic Ganoids are almost all similarly allied to *Lepidosteus.*[5]

Again, what can be more remarkable than the singular constancy of structure preserved throughout a vast period of time by the family of the Pycnodonts and by that of the true Cœlacanths; the former persisting, with but insignificant modifications, from the Carboniferous to the Tertiary rocks, inclusive; the latter existing, with still less change, from the Carboniferous rocks to the Chalk, inclusive?

Among Reptiles, the highest living group, that of the Crocodilia, is represented, at the early part of the Mesozoic epoch, by species identical in the essential characters of their organisation with those now living, and differing from the latter only in such matters as the form of the articular facets of the vertebral centra, in the extent to which the nasal passages are separated from the cavity of the mouth by bone, and in the proportions of the limbs.

And even as regards the Mammalia, the scanty remains of Triassic and Oolitic species afford no foundation for the supposition that the organisa[295]tion of the oldest forms differed nearly so much from some of those which now live as these differ from one another.

It is needless to multiply these instances; enough has been said to justify the statement that, in view of the immense diversity of known animal and vegetable forms, and the enormous lapse of time indicated by the accumulation of fossiliferous strata, the only circumstance to be wondered at is, not that the changes of life, as exhibited by positive evidence, have been so great, but that they have been so small.

Be they great or small, however, it is desirable to attempt to estimate them. Let us, therefore, take each great division of the animal world in succession, and, whenever an order or a family can be shown to have had a prolonged existence, let us endeavour to ascertain how far the later members of the group differ from the earlier ones. If these later members, in all or in many cases, exhibit a certain amount of modification, the fact is, so far, evidence in favour of a general law of change; and, in a rough way, the rapidity of that change will be measured by the demonstrable amount of modification. On the other hand, it must be recollected that the absence of any modification, while it may leave the doctrine of the existence of a law of change without positive support, cannot possibly disprove all forms of that doctrine, though [296] it may afford a sufficient refutation of any of them.

The Protozoa.–The Protozoa are represented throughout the whole range of geological series, from the Lower Silurian formation to the present day. The most ancient forms recently made known by Ehrenberg are exceedingly like those which now exist: no one has ever pretended that the difference between any ancient and any modern Foraminifera is of more than generic values nor are the oldest Foraminifera either simpler, more embryonic, or less differentiated, than the existing forms.

The Cœlenterata.–The Tabulate Corals have existed from the Silurian epoch to the present day, but I am not aware that the ancient *Heliolites* possesses a single mark of a more embryonic or less differentiated character, or less high organisation, than the existing *Heliopora.* As for the Aporose Corals, in what respect is the Silurian *Palæocyclus* less highly organised or more embryonic than the modern *Fungia*, or the Liassic Aporosa than the existing members of the same families?

The *Mollusca.*–In what sense is the living *Waldheimia* less embryonic, or more specialised; than the palæozoic *Spirifer;* or the existing *Rhynchonellæ, Craniæ, Discinæ, Lingulæ,* than the Silurian species of the same genera? In what sense can *Loligo* or *Spirula* be said to be more [297] specialised, or less embryonic, than *Belemnites;* or the modern species of Lamellibranch and Gasteropod genera, than the

Silurian species of the same genera?

The Annulosa.–The Carboniferous Insecta and Arachnida are neither less specialised, nor more embryonic, than these that now live, nor are the Liassic Cirripedia and Macrura; while several of the Brachyura, which appear in the Chalk, belong to existing genera; and none exhibit either an intermediate, or an embryonic, character.

The Vertebrata.–Among fishes I have referred to the Cœlacanthini (comprising the genera *Cœlacanthus, Holophagus, Undina,* and *Macropoma*) as affording an example of a persistent type; and it is most remarkable to note the smallness of the differences between any of these fishes (affecting at most the proportions of the body and fins, and the character and sculpture of the scales), notwithstanding their enormous range in time. In all the essentials of its very peculiar structure, the *Macropoma* of the Chalk is identical with the *Cœlacanthus* of the Coal. Look at the genus *Lepidotus,* again, persisting without a modification of importance from the Liassic to the Eocene formations inclusively.

Or among the Teleostei–in what respect is the *Beryx* of the Chalk more embryonic, or [298] less differentiated, than *Beryx lineatus* of King George's Sound?

Or to turn to the higher Vertebrata–in what sense are the Liassic Chelonia inferior to those which now exist? How are the Cretaceous Ichthyosauria, Plesiosauria, or Pterosauria less embryonic, or more differentiated, species than those of the Lias?

Or lastly, in what circumstance is the *Phascolotherium* more embryonic, or of a more generalised type, than the modern Opossum; or a *Lophiodon* or a *Palæotherium,* than a modern *Tapirus* or *Hyrax*?

These examples might be almost indefinitely multiplied, but surely they are sufficient to prove that the only safe and unquestionable testimony we can procure–positive evidence–fails to demonstrate any sort of progressive modification towards a less embryonic, or less generalised, type in a great many groups of animals of long-continued geological existence. In these groups there is abundant evidence of variation–none of what is ordinarily understood as progression; and, if the known geological record is to be regarded as even any considerable fragment of the whole, it is inconceivable that any theory of a necessarily progressive development can stand, for the numerous orders and families cited afford no trace of such a process.

But it is a most remarkable fact, that, while the [299] groups which have been mentioned, and many besides, exhibit no sign of progressive modification, there are others, co-existing with them, under the same conditions, in which more or less distinct indications of such a process seems to be traceable. Among such indications I may remind you of the predominance of Holostome Gasteropoda in the older rocks as compared with that of Siphonostone Gasteropoda in the later. A case less open to the objection of negative evidence, however, is that afforded by the Tetrabranchiate Cephalopoda, the forms of the shells and of the septal sutures exhibiting a certain increase of complexity in the newer genera. Here, however, one is met at once with the occurrence of *Orthoceras* and *Baculites* at the two ends of the

series, and of the fact that one of the simplest Genera, *Nautilus,* is that which now exists.

The Crinoidea, in the abundance of stalked forms in the ancient formations as compared with their present rarity, seem to present us with a fair case of modification from a more embryonic towards a less embryonic condition. But then, on careful consideration of the facts, the objection arises that the stalk, calyx, and arms of the palæozoic Crinoid are exceedingly different from the corresponding organs of a larval *Comatula;* and it might with perfect justice be argued that *Actinocrinus* and *Eucalyptocrinus,* for example, depart to the full as widely, in one direction, from the stalked [300] embryo of *Comatula,* as *Comatula* itself does in the other.

The Echinidea, again, are frequently quoted as exhibiting a gradual passage from a more generalised to a more specialised type, seeing that the elongated, or oval, Spatangoids appear after the spheroidal Echinoids. But here it might be argued, on the other hand, that the spheroidal Echinoids, in reality, depart further from the general plan and from the embryonic form than the elongated Spatangoids do; and that the peculiar dental apparatus and the pedicellariæ of the former are marks of at least as great differentiation as the petaloid ambulacra and semitæ of the latter.

Once more, the prevalence of Macrurous before Brachyurous Podophthalmia is, apparently, a fair piece of evidence in favour of progressive modification in the same order of Crustacea; and yet the case will not stand much sifting, seeing that the Macrurous Podophthalmia depart as far in one direction from the common type of Podophthalmia, or from any embryonic condition of the Brachyura, as the Brachyura do in the other; and that the middle terms between Macrura and Brachyura–the Anomura–are little better represented in the older Mesozoic rocks than the Brachyura are.

None of the cases of progressive modification which are cited from among the Invertebrata appear to me to have a foundation less open to [301] criticism than these; and if this be so, no careful reasoner would, I think, be inclined to lay very great stress upon them. Among the Vertebrata, however, there are a few examples which appear to be far less open to objection.

It is, in fact, true of several groups of Vertebrata which have lived through a considerable range of time, that the endoskeleton (more particularly the spinal column) of the older genera presents a less ossified, and, so far, less differentiated, condition than that of the younger genera. Thus the Devonian Ganoids, though almost all members of the same sub-order as *Polypterus*, and presenting numerous important resemblances to the existing genus, which possesses biconcave vertebræ, are, for the most part, wholly devoid of ossified vertebral centra. The Mesozoic Lepidosteidæ, again, have, at most, biconcave vertebræ, while the existing *Lepidosteus* has Salamandroid, opisthocœlous, vertebræ. So, none of the Palæozoic Sharks have shown themselves to be possessed of ossified vertebræ, while the majority of modern Sharks possess such vertebræ. Again, the more ancient Crocodilia and Lacertilia have vertebræ with the articular facets of their centra flattened or biconcave, while the modern members of the same group have them procœlous. But the most remarkable examples of progressive modification of the vertebral column, in correspondence with geological age, are those afforded by [392] the Pycnodonts among fish, and the Labyrinthodonts among Amphibia.

The late able ichthyologist Heckel pointed out the fact, that, while the Pycnodonts never possess true vertebral centra, they differ in the degree of expansion and extension of the ends of the bony arches of the vertebræ upon the sheath of the notochord; the Carboniferous forms exhibiting hardly any such expansion, while the Mesozoic genera present a greater and greater development, until, in the Tertiary forms, the expanded ends become suturally united so as to form a sort of false vertebra. Hermann von Meyer, again, to whose luminous researches we are indebted for our present large knowledge of the organisation of the older Labyrinthodonts, has proved that the Carboniferous *Archegosaurus* had very imperfectly developed vertebral centra, while the Triassic *Mastodonsaurus* had the same parts completely ossified.[6]

The regularity and evenness of the dentition of the *Anoplotherium,* as contrasted with that of existing Artiodactyles, and the assumed nearer approach of the dentition of certain ancient Carnivores to the typical arrangement, have also been cited as exemplifications of a law of progressive development, but I know of no other cases based on [303] positive evidence which are worthy of particular notice.

What, then, does an impartial survey of the positively ascertained truths of palæontology testify in relation to the common doctrines of progressive modification, which suppose that modification to have taken place by a necessary progress from more to less embryonic forms, or from more to less generalised types, within the limits of the period represented by the fossiliferous rocks?

It negatives those doctrines; for it either shows us no evidence of any such modification, or demonstrates it to have been very slight; and as to the nature of that modification, it yields no evidence whatsoever that the earlier members of any long-continued group were more generalised in structure than the later ones. To a certain extent, indeed, it may be said that imperfect ossification of the vertebral column is an embryonic character; but, on the other hand, it would be extremely incorrect to suppose that the vertebral columns of the older Vertebrata are in any sense embryonic in their whole structure.

Obviously, if the earliest fossiliferous rocks now known are coëval with the commencement of life, and if their contents give us any just conception of the nature and the extent of the earliest fauna and flora, the insignificant amount of modification which can be demonstrated to have taken place in any one group of animals, or plants, is quite in[304]compatible with the hypothesis that all living forms are the results of a necessary process of progressive development, entirely comprised within the time represented by the fossiliferous rocks.

Contrariwise, any admissible hypothesis of progressive modification must be compatible with persistence without progression, through indefinite periods. And should such an hypothesis eventually be proved to be true, in the only way in which it can be demonstrated, viz., by observation and experiment upon the existing forms of life, the conclusion will inevitably present itself, that the Palæozoic, Mesozoic, and Cainozoic faunæ and floræ, taken together, bear somewhat the same proportion to the whole series of living beings which have occupied this globe, as the existing fauna and flora do to them.

Such are the results of palæontology as they appear, and have for some years appeared, to the mind of an inquirer who regards that study simply as one of the applications of the great biological sciences, and who desires to see it placed upon the same sound basis as other branches of physical inquiry. If the arguments which have been brought forward are valid, probably no one, in view of the present state of opinion, will be inclined to think the time wasted which has been spent upon their elaboration.

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1 "Le plus grand service qu'on puisse rendre à la science est d'y faire place nette avant d'y rien construire."–Cuvier.

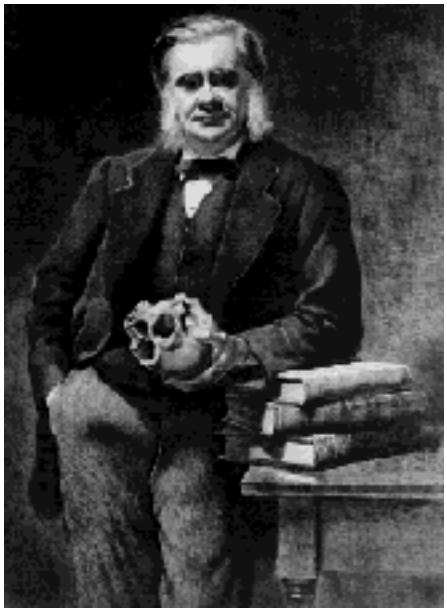
2 Anniversary Address for 1851, *Quart Journ. Geol. Soc.* vol. vii.

3 See Hooker's *Introductory Essay to the Flora of Tasmania*, p. xxiii.

4 See the abstract of a Lecture "On the Persistent Types of Animal Life," in the *Notices of the Meetings of the Royal Institution of Great Britain.*–June 3, 1859, vol. iii, p. 151.

5 "Memoirs of the Geological Survey of the United Kingdom.–Decade x. Preliminary Essay upon the Systematic Arrangement of the Fishes of the Devonian Epoch."

6 As this address is passing through the press (March 7, 1862), evidence lies before me of the existence of a new Labyrinthodont (*Pholidogaster*), from the Edinburgh coal field with well-ossified vertebral centra.



On a Piece of Chalk

Macmillan's Magazine (1868)

Collected Essays VIII

[1] If a well were sunk at our feet in the midst of the city of Norwich, the diggers would very soon find themselves at work in that white substance almost too soft to be called rock, with which we are all familiar as "chalk."

Not only here, but over the whole country of Norfolk, the well-sinker might carry his shaft down many hundred feet without coming to the end of the chalk; and, on the sea-coast, where the waves have pared away the face of the land which breasts them, the scarped faces of the high cliffs are often wholly formed of the same material. Northward, the chalk may be followed as far as Yorkshire; on the south coast it appears abruptly in the picturesque western bays of Dorset, and breaks into the Needles of the Isle of Wight; while on the shores of Kent it supplies that long [2] line of white cliffs to which England owes her name of Albion.

Were the thin soil which covers it all washed away, a curved band of white chalk, here broader, and there narrower, might be followed diagonally across England from Lulworth in Dorset, to Flamborough Head in Yorkshire–a distance of over 280 miles as the crow flies. From this band to the North Sea, on the east, and the Channel, on the south, the chalk is largely hidden by other deposits; but, except in the Weald of Kent and Sussex, it enters into the very foundation of all the southeastern counties.

Attaining, as it does in some places, a thickness of more than a thousand feet, the English chalk must be admitted to be a mass of considerable magnitude. Nevertheless, it covers but an insignificant portion of the whole area occupied by the chalk formation of the globe, much of which has the same general characters as ours, and is found in detached patches, some less, and others more extensive, than the English. Chalk occurs in north-west Ireland; it stretches over a large part of France,–the chalk which underlies Paris being, in fact, a continuation of that of the London basin; it runs through Denmark and Central Europe, and extends southward to North Africa; while eastward, it appears in the Crimea and in Syria, and may be traced as far as the shores of the Sea of Aral, in Central Asia. If all the points at which [3] true chalk occurs were circumscribed, they would lie within an irregular oval about 3,000 miles in long diameter–the area of which would be as great as that of Europe, and would many times exceed that of the largest existing inland sea–the Mediterranean.

Thus the chalk is no unimportant element in the masonry of the earth's crust, and it impresses a peculiar stamp, varying with the conditions to which it is exposed, on the scenery of the districts in which it occurs. The undulating downs and rounded coombs, covered with sweet-grassed turf, of our inland chalk country, have a peacefully domestic and mutton-suggesting prettiness, but can hardly be called either grand or beautiful. But on our southern coasts, the wall-sided cliffs, many hundred feet high, with vast

needles and pinnacles standing out in the sea, sharp and solitary enough to serve as perches for the wary cormorant, confer a wonderful beauty and grandeur upon the chalk headlands. And, in the East, chalk has its share in the formation of some of the most venerable of mountain ranges, such as the Lebanon.

What is this wide-spread component of the surface of the earth? and whence did it come?

You may think this no very hopeful inquiry. You may not unnaturally suppose that the attempt to solve such problems as these can lead [4] to no result, save that of entangling the inquirer in vague speculations, incapable of refutation and of verification. If such were really the case, I should have selected some other subject than a "piece of chalk" for my discourse. But, in truth, after much deliberation, I have been unable to think of any topic which would so well enable me to lead you to see how solid is the foundation upon which some of the most startling conclusions of physical science rest.

A great chapter of the history of the world is written in the chalk. Few passages in the history of man can be supported by such an overwhelming mass of direct and indirect evidence as that which testifies to the truth of the fragment of the history of the globe, which I hope to enable you to read, with your own eyes, to-night. Let me add, that few chapters of human history have a more profound significance for ourselves. I weigh my words well when I assert, that the man who should know the true history of the bit of chalk which every carpenter carries about in his breeches-pocket, though ignorant of all other history, is likely, if he will think his knowledge out to its ultimate results, to have a truer, and therefore a better, conception of this wonderful universe, and of man's relation to it, than the most learned student who is deep-read in the records of humanity and ignorant of those of Nature.

[5] The language of the chalk is not hard to learn, not nearly so hard as Latin, if you only want to get at the broad features of the story it has to tell; and I propose that we now set to work to spell that story out together.

We all know that if we "burn" chalk the result is quick-lime. Chalk, in fact, is a compound of carbonic acid gas, and lime, and when you make it very hot the carbonic acid flies away and the lime is left. By this method of procedure we see the lime, but we do not see the carbonic acid. If, on the other hand, you were to powder a little chalk and drop it into a good deal of strong vinegar, there would be a great bubbling and fizzing, and, finally, a clear liquid, in which no sign of chalk would appear. Here you see the carbonic acid in the bubbles; the lime, dissolved in the vinegar, vanishes from sight. There are a great many other ways of showing that chalk is essentially nothing but carbonic acid and quicklime. Chemists enunciate the result of all the experiments which prove this, by stating that chalk is almost wholly composed of "carbonate of lime."

It is desirable for us to start from the knowledge of this fact, though it may not seem to help us very far towards what we seek. For carbonate of lime is a widely-spread substance, and is met with under very various conditions. All sorts of limestones are composed of more or less pure [6] carbonate of lime. The crust which is often deposited by waters which have drained through limestone rocks, in the form of what are called stalagmites and stalactites, is carbonate of lime. Or, to take a more familiar example, the

fur on the inside of a tea-kettle is carbonate of lime; and, for anything chemistry tells us to the contrary, the chalk might be a kind of gigantic fur upon the bottom of the earth-kettle, which is kept pretty hot below.

Let us try another method of making the chalk tell us its own history. To the unassisted eye chalk looks simply like a very loose and open kind of stone. But it is possible to grind a slice of chalk down so thin that you can see through it–until it is thin enough, in fact, to be examined with any magnifying power that may be thought desirable. A thin slice of the fur of a kettle might be made in the same way. If it were examined microscopically, it would show itself to be a more or less distinctly laminated mineral substance, and nothing more.

But the slice of chalk presents a totally different appearance when placed under the microscope. The general mass of it is made up of very minute granules; but, imbedded in this matrix, are innumerable bodies, some smaller and some larger, but, on a rough average, not more than a hundredth of an inch in diameter, having a well-defined shape and structure. A cubic inch of [7] some specimens of chalk may contain hundreds of thousands of these bodies, compacted together with incalculable millions of the granules.

The examination of a transparent slice gives a good notion of the manner in which the components of the chalk are arranged, and of their relative proportions. But, by rubbing up some chalk with a brush in water and then pouring off the milky fluid, so as to obtain sediments of different degrees of fineness, the granules and the minute rounded bodies may be pretty well separated from one another, and submitted to microscopic examination, either as opaque or as transparent objects. By combining the views obtained in these various methods, each of the rounded bodies may be proved to be a beautifully-constructed calcareous fabric, made up of a number of chambers, communicating freely with one another. The chambered bodies are of various forms. One of the commonest is something like a badly-grown raspberry, being formed of a number of nearly globular chambers of different sizes congregated together. It is called *Globigerina*, and some specimens of chalk consist of little else than *Globigerinæ* and granules. Let us fix our attention upon the *Globigerina*. It is the spoor of the game we are tracking. If we can learn what it is and what are the conditions of its existence, we shall see our way to the origin and past history of the chalk.

[8] A suggestion which may naturally enough present itself is, that these curious bodies are the result of some process of aggregation which has taken place in the carbonate of lime; that, just as in winter, the rime on our windows simulates the most delicate and elegantly arborescent foliage–proving that the mere mineral water may, under certain conditions, assume the outward form of organic bodies–so this mineral substance, carbonate of lime, hidden away in the bowels of the earth, has taken the shape of these chambered bodies. I am not raising a merely fanciful and unreal objection. Very learned men, in former days, have even entertained the notion that all the formed things found in rocks are of this nature; and if no such conception is at present held to be admissible, it is because long and varied experience has now shown that mineral matter never does assume the form and structure we find in fossils. If any one were to try to persuade you that an oyster-shell (which is also chiefly composed of carbonate of lime) had crystallized out of sea-water I suppose you would laugh at the absurdity. Your laughter would

be justified by the fact that all experience tends to show that oyster-shells are formed by the agency of oysters, and in no other way. And if there were no better reasons, we should be justified, on like grounds, in believing that *Globigerina* is not the product of anything but vital activity.

[9] Happily, however, better evidence in proof of the organic nature of the *Globigerinæ* than that of analogy is forthcoming. It so happens that calcareous skeletons, exactly similar to the *Globigerinæ* of the chalk, are being formed, at the present moment, by minute living creatures, which flourish in multitudes, literally more numerous than the sands of the sea-shore, over a large extent of that part of the earth's surface which is covered by the ocean.

The history of the discovery of these living *Globigerinæ*, and of the part which they play in rock building, is singular enough. It is a discovery which, like others of no less scientific importance, has arisen, incidentally, out of work devoted to very different and exceedingly practical interests. When men first took to the sea, they speedily learned to look out for shoals and rocks; and the more the burthen of their ships increased, the more imperatively necessary it became for sailors to ascertain with precision the depth of the waters they traversed. Out of this necessity grew the use of the lead and sounding line; and, ultimately, marine-surveying, which is the recording of the form of coasts and of the depth of the sea, as ascertained by the sounding lead, upon charts.

At the same time, it became desirable to ascertain and to indicate the nature of the sea-bottom, since this circumstance greatly affects its goodness [10] as holding ground for anchors. Some ingenious tar, whose name deserves a better fate than the oblivion into which it has fallen, attained this object by "arming" the bottom of the lead with a lump of grease, to which more or less of the sand or mud, or broken shells, as the case might be, adhered, and was brought to the surface. But, however well adapted such an apparatus might be for rough nautical purposes, scientific accuracy could not be expected from the armed lead, and to remedy its defects (especially when applied to sounding in great depths) Lieut. Brooke, of the American Navy, some years ago invented a most ingenious machine, by which a considerable portion of the superficial layer of the sea-bottom can be scooped out and brought up from any depth to which the lead descends. In 1853, Lieut. Brooke obtained mud from the bottom of the North Atlantic, between Newfoundland and the Azores, at a depth of more than 10,000 feet, or two miles, by the help of this sounding apparatus. The specimens were sent for examination to Ehrenberg of Berlin, and to Bailey of West Point, and those able microscopists found that this deep-sea mud was almost entirely composed of the skeletons of living organisms–the greater proportion of these being just like the *Globigerinæ* already known to occur in the chalk.

Thus far, the work had been carried on simply in the interest of science, but Lieut. Brooke's [11] method of sounding acquired a high commercial value, when the enterprise of laying down the telegraph-cable between this country and the United States was undertaken. For it became a matter of immense importance to know, not only the depth of the sea over the whole line along which the cable was to be laid, but the exact nature of the bottom, so as to guard against chances of cutting or fraying the strands of that costly rope. The Admiralty consequently ordered Captain Dayman, an old friend and shipmate of mine, to ascertain the depth over the whole line of the cable, and to bring back specimens of the bottom. In former days, such a command as this might have sounded very much like one of the impossible things

which the young Prince in the Fairy Tales is ordered to do before he can obtain the hand of the Princess. However, in the months of June and July, 1857, my friend performed the task assigned to him with great expedition and precision, without, so far as I know, having met with any reward of that kind. The specimens of Atlantic mud which he procured were sent to me to be examined and reported upon.[1]

[12] The result of all these operations is, that we know the contours and the nature of the surface-soil covered by the North Atlantic for a distance of 1,700 miles from east to west, as well as we know that of any part of the dry land. It is a prodigious plain–one of the widest and most even plains in the world. If the sea were drained off, you might drive a waggon all the way from Valentia, on the west coast of Ireland, to Trinity Bay, in Newfoundland. And, except upon one sharp incline about 200 miles from Valentia, I am not quite sure that it would even be necessary to put the skid on, so gentle are the ascents and descents upon that long route. From Valentia the road would lie down-hill for about 200 miles to the point at which the bottom is now covered by 1,700 fathoms of sea-water. Then would come the central plain, more than a thousand miles wide, the inequalities of the surface of which would be hardly perceptible, though the depth of water upon it now varies from 10,000 to 15,000 feet; and there are places in which Mont Blanc might be sunk without showing its peak above water. Beyond this, the ascent on the American side commences, and gradually leads, for about 300 miles, to the Newfoundland shore.

Almost the whole of the bottom of this central plain (which extends for many hundred miles in a north and south direction) is covered by a fine mud, which, when brought to the surface, dries [13] into a greyish white friable substance. You can write with this on a blackboard, if you are so inclined; and, to the eye, it is quite like very soft, greyish chalk. Examined chemically, it proves to be composed almost wholly of carbonate of lime; and if you make a section of it, in the same way as that of the piece of chalk was made, and view it with the microscope, it presents innumerable *Globigerinæ* imbedded in a granular matrix. Thus this deep-sea mud is substantially chalk. I say substantially, because there are a good many minor differences; but as these have no bearing on the question immediately before us,–which is the nature of the *Globigerinæ* of the chalk,–it is unnecessary to speak of them.

Globigerinæ of every size, from the smallest to the largest, are associated together in the Atlantic mud, and the chambers of many are filled by a soft animal matter. This soft substance is, in fact, the remains of the creature to which the *Globigerina* shell, or rather skeleton, owes its existence and which is an animal of the simplest imaginable description. It is, in fact, a mere particle of living jelly, without defined parts of any kind–without a mouth, nerves, muscles, or distinct organs, and only manifesting its vitality to ordinary observation by thrusting out and retracting from all parts of its surface, long filamentous processes, which serve for arms and legs. Yet this amorphous particle, devoid of everything which, in the higher animals, [14] we call organs, is capable of feeding, growing, and multiplying; of separating from the ocean the small proportion of carbonate of lime which is dissolved in sea-water; and of building up that substance into a skeleton for itself, according to a pattern which can be imitated by no other known agency.

The notion that animals can live and flourish in the sea, at the vast depths from which apparently living

Globigerinæ have been brought up, does not agree very well with our usual conceptions respecting the conditions of animal life; and it is not so absolutely impossible as it might at first sight appear to be, that the *Globigerinæ* of the Atlantic sea-bottom do not live and die where they are found.

As I have mentioned, the soundings from the great Atlantic plain are almost entirely made up of *Globigerinæ* with the granules which have been mentioned, and some few other calcareous shells; but a small percentage of the chalky mud–perhaps at most some five per cent. of it–is of a different nature, and consists of shells and skeletons composed of silex, or pure flint. These silicious bodies belong partly to the lowly vegetable organisms which are called *Diatomaceæ,* and partly to the minute, and extremely simple, animals, termed *Radiolaria.* It is quite certain that these creatures do not live at the bottom of the ocean, but at its surface–where they may be [15] obtained in prodigious numbers by the use of a properly constructed net. Hence it follows that these silicious organisms, though they are not heavier than the lightest dust, must have fallen, in some cases, through fifteen thousand feet of water, before they reached their final resting-place on the ocean floor. And considering how large a surface these bodies expose in proportion to their weight, it is probable that they occupy a great length of time in making their burial journey from the surface of the Atlantic to the bottom.

But if the *Radiolaria* and Diatoms are thus rained upon the bottom of the sea, from the superficial layer of its waters in which they pass their lives, it is obviously possible that the *Globigerinæ* may be similarly derived; and if they were so, it would be much more easy to understand how they obtain their supply of food than it is at present. Nevertheless, the positive and negative evidence all points the other way. The skeletons of the full-grown, deep-sea *Globigerinæ* are so remarkably solid and heavy in proportion to their surface as to seem little fitted for floating; and, as a matter of fact, they are not to be found along with the Diatoms and *Radiolaria* in the uppermost stratum of the open ocean. It has been observed, again, that the abundance of *Globigerinæ,* in proportion to other organisms, of like kind, increases with the depth of the sea; and [16] that deep-water *Globigerinæ* are larger than those which live in shallower parts of the sea; and such facts negative the supposition that these organisms have been swept by currents from the shallows into the deeps of the Atlantic. It therefore seems to be hardly doubtful that these wonderful creatures live and die at the depths in which they are found.[2]

However, the important points for us are, that the living *Globigerinæ* are exclusively marine animals, the skeletons of which abound at the bottom of deep seas; and that there is not a shadow of reason for believing that the habits of the *Globigerinæ* of the chalk differed from those of the existing species. But if this be true, there is no escaping the conclusion that the chalk itself is the dried mud of an ancient deep sea.

In working over the soundings collected by Captain Dayman, I was surprised to find that many of what I have called the "granules" of that mud were not, as one might have been tempted [17] to think at first, the mere powder and waste of *Globigerinæ,* but that they had a definite form and size. I termed these bodies "*coccoliths,*" and doubted their organic nature. Dr. Wallich verified my observation, and added the interesting discovery that, not unfrequently, bodies similar to these "coccoliths" were aggregated together into spheroids, which he termed "*coccospheres.*" So far as we knew, these bodies, the nature of

which is extremely puzzling and problematical, were peculiar to the Atlantic soundings. But, a few years ago, Mr. Sorby, in making a careful examination of the chalk by means of thin sections and otherwise, observed, as Ehrenberg had done before him, that much of its granular basis possesses a definite form. Comparing these formed particles with those in the Atlantic soundings, he found the two to be identical; and thus proved that the chalk, like the surroundings, contains these mysterious coccoliths and coccospheres. Here was a further and most interesting confirmation, from internal evidence, of the essential identity of the chalk with modern deep-sea mud. *Globigerinæ,* coccoliths, and coccospheres are found as the chief constituents of both, and testify to the general similarity of the conditions under which both have been formed.[3]

The evidence furnished by the hewing, facing, [18] and superposition of the stones of the Pyramids, that these structures were built by men, has no greater weight than the evidence that the chalk was built by *Globigerinæ* and the belief that those ancient pyramid-builders were terrestrial and air-breathing creatures like ourselves, is not better based than the conviction that the chalk-makers lived in the sea. But as our belief in the building of the Pyramids by men is not only grounded on the internal evidence afforded by these structures, but gathers strength from multitudinous collateral proofs and is clinched by the total absence of any reason for a contrary belief; so the evidence drawn from the *Globigerinæ* that the chalk is an ancient sea bottom; is fortified by innumerable independent lines of evidence; and our belief in the truth of the conclusion to which all positive testimony tends, receives the like negative justification from the fact that no other hypothesis has a shadow of foundation.

It may be worth while briefly to consider a few of these collateral proofs that the chalk was deposited at the bottom of the sea. The great mass of the chalk is composed, as we have seen, of the skeletons of *Globigerinæ,* and other simple organisms, imbedded in granular matter. Here and there, however, this hardened mud of the [19] ancient sea reveals the remains of higher animals which have lived and died, and left their hard parts in the mud, just as the oysters die and leave their shells behind them, in the mud of the present seas.

There are, at the present day, certain groups of animals which are never found in fresh waters, being unable to live anywhere but in the sea. Such are the corals; those corallines which are called *Polyzoa;* those creatures which fabricate the lamp-shells, and are called *Brachiopoda;* the pearly *Nautilus* and all animals allied to it; and all the forms of sea-urchins and star-fishes. Not only are all these creatures confined to salt water at the present day; but, so far as our records of the past go, the conditions of their existence have been the same: hence, their occurrence in any deposit is as strong evidence as can be obtained, that that deposit was formed in the sea. Now the remains of animals of all kinds which have been enumerated, occur in the chalk, in greater or less abundance; while not one of those forms of shell-fish which are characteristic of fresh water has yet been observed in it.

When we consider that the remains of more than three thousand distinct species of aquatic animals have been discovered among the fossils of the chalk, that the great majority of them are of such forms as are now met with only in the sea, and that there is no reason to believe that any [20] one of them inhabited fresh water–the collateral evidence that the chalk represents an ancient sea-bottom acquires as great

force as the proof derived from the nature of the chalk itself. I think you will now allow that I did not overstate my case when I asserted that we have as strong grounds for believing that all the vast area of dry land, at present occupied by the chalk, was once at the bottom of the sea, as we have for any matter of history whatever; while there is no justification for any other belief.

No less certain it is that the time during which the countries we now call south-east England, France, Germany, Poland, Russia, Egypt, Arabia, Syria, were more or less completely covered by a deep sea, was of considerable duration. We have already seen that the chalk is, in places, more than a thousand feet thick. I think you will agree with me, that it must have taken some time for the skeletons of animalcules of a hundredth of an inch in diameter to heap up such a mass as that. I have said that throughout the thickness of the chalk the remains of other animals are scattered. These remains are often in the most exquisite state of preservation. The valves of the shell-fishes are commonly adherent; the long spines of some of the sea-urchins, which would be detached by the smallest jar, often remain in their places. In a word, it is certain that these animals have lived and died [21] when the place which they now occupy was the surface of as much of the chalk as had then been deposited; and that each has been covered up by the layer of *Globigerina* mud, upon which the creatures imbedded a little higher up have, in like manner, lived and died. But some of these remains prove the existence of reptiles of vast size in the chalk sea. These lived their time, and had their ancestors and descendants, which assuredly implies time, reptiles being of slow growth.

There is more curious evidence, again, that the process of covering up, or, in other words, the deposit of *Globigerina* skeletons, did not go on very fast. It is demonstrable that an animal of the cretaceous sea might die, that its skeleton might lie uncovered upon the sea-bottom long enough to lose all its outward coverings and appendages by putrefaction; and that, after this had happened, another animal might attach itself to the dead and naked skeleton, might grow to maturity, and might itself die before the calcareous mud had buried the whole.

Cases of this kind are admirably described by Sir Charles Lyell. He speaks of the frequency with which geologists find in the chalk a fossilized sea urchin, to which is attached the lower valve of a *Crania*. This is a kind of shell-fish, with a shell composed of two pieces, of which, as in the oyster, one is fixed and the other free.

[22] "The upper valve is almost invariably wanting, though occasionally found in a perfect state of preservation in the white chalk at some distance. In this case, we see clearly that the sea-urchin first lived from youth to age, then died and lost its spines, which were carried away. Then the young *Crania* adhered to the bared shell, grew and perished in its turn; after which, the upper valve was separated from the lower, before the Echinus became enveloped in chalky mud."[4]

A specimen in the Museum of Practical Geology, in London, still further prolongs the period which must have elapsed between the death of the sea-urchin, and its burial by the *Globigerinæ*. For the outward face of the valve of a *Crania*, which is attached to a sea urchin (*Micraster*), is itself overrun by an incrusting coralline, which spreads thence over more or less of the surface of the sea urchin. It

follows that, after the upper valve of the *Crania* fell off, the surface of the attached valve must have remained exposed long enough to allow of the growth of the whole coralline, since corallines do not live embedded in mud.

The progress of knowledge may, one day, enable us to deduce from such facts as these the maximum rate at which the chalk can have accumulated and thus to arrive at the minimum [23] duration of the chalk period. Suppose that the valve of the *Crania* upon which a coralline has fixed itself in the way just described is so attached to the sea urchin that no part of it is more than an inch above the face upon which the sea urchin rests. Then, as the coralline could not have fixed itself if the *Crania* had been covered up with chalk mud and could not have lived had itself been so covered, it follows that an inch of chalk mud could not have accumulated within the time between the death and decay of the soft parts of the sea urchin and the growth of the coralline to the full size which it has attained. If the decay of the soft parts of the sea-urchin; the attachment, growth to maturity, and decay of the *Crania;* and the subsequent attachment and growth of the coralline, took a year (which is a low estimate enough), the accumulation of the inch of chalk must have taken more than a year; and the deposit of a thousand feet of chalk must, consequently, have taken more than twelve thousand years.

The foundation of all this calculation is, of course, a knowledge of the length of time the *Crania* and the coralline needed to attain their full size, and, on this head, precise knowledge is at present wanting. But there are circumstances which tend to show that nothing like an inch of chalk has accumulated during the life of a *Crania,* and, on any probable estimate of the length of [24] that life, the chalk period must have had a much longer duration than that thus roughly assigned to it.

Thus, not only is it certain that the chalk is the mud of an ancient sea-bottom; but it is no less certain, that the chalk sea existed during an extremely long period, though we may not be prepared to give a precise estimate of the length of that period in years. The relative duration is clear, though the absolute duration may not be definable. The attempt to affix any precise date to the period at which the chalk sea began, or ended, its existence, is baffled by difficulties of the same kind. But the relative age of the cretaceous epoch may be determined with as great ease and certainty as the long duration of that epoch.

You will have heard of the interesting discoveries recently made, in various parts of Western Europe, of flint implements, obviously worked into shape by human hands, under circumstances which show conclusively that man is a very ancient denizen of these regions. It has been proved that the whole populations of Europe, whose existence has been revealed to us in this way, consisted of savages, such as the Esquimaux are now; that, in the country which is now France, they hunted the reindeer, and were familiar with the ways of the mammoth and the bison. The physical geography of France was in those days different from what it [25] is now–the river Somme, for instance, having cut its bed a hundred feet deeper between that time and this; and, it is probable, that the climate was more like that of Canada or Siberia, than that of Western Europe.

The existence of these people is forgotten even in the traditions of the oldest historical nations. The name and fame of them had utterly vanished until a few years back; and the amount of physical change

which has been effected since their day renders it more than probable that, venerable as are some of the historical nations, the workers of the chipped flints of Hoxne or of Amiens are to them, as they are to us, in point of antiquity. But, if we assign to these hoar relics of long-vanished generations of men the greatest age that can possibly be claimed for them, they are not older than the drift, or boulder clay, which, in comparison with the chalk, is but a very juvenile deposit. You need go no further than your own sea-board for evidence of this fact. At one of the most charming spots on the coast of Norfolk, Cromer, you will see the boulder clay forming a vast mass, which lies upon the chalk, and must consequently have come into existence after it. Huge boulders of chalk are, in fact included in the clay, and have evidently been brought to the position they now occupy by the same agency as that which has planted blocks of syenite from Norway side by side with them.

[26] The chalk, then, is certainly older than the boulder clay. If you ask how much, I will again take you no further than the same spot upon your own coasts for evidence. I have spoken of the boulder clay and drift as resting upon the chalk. That is not strictly true. Interposed between the chalk and the drift is a comparatively insignificant layer, containing vegetable matter. But that layer tells a wonderful history. It is full of stumps of trees standing as they grew. Fir-trees are there with their cones, and hazel-bushes with their nuts; there stand the stools of oak and yew trees, beeches and alders. Hence this stratum is appropriately called the "forest-bed."

It is obvious that the chalk must have been upheaved and converted into dry land, before the timber trees could grow upon it. As the bolls of some of these trees are from two to three feet in diameter, it is no less clear that the dry land thus formed remained in the same condition for long ages. And not only do the remains of stately oaks and well-grown firs testify to the duration of this condition of things, but additional evidence to the same effect is afforded by the abundant remains of elephants, rhinoceroses, hippopotamuses, and other great wild beasts, which it has yielded to the zealous search of such men as the Rev. Mr. Gunn. When you look at such a collection as he has formed, and bethink you that these elephantine bones did veritably carry their owners about, [27] and these great grinders crunch, in the dark woods of which the forest-bed is now the only trace, it is impossible not to feel that they are as good evidence of the lapse of time as the annual rings of the tree stumps.

Thus there is a writing upon the wall of cliffs at Cromer, and whoso runs may read it. It tells us, with an authority which cannot be impeached, that the ancient sea bed of the chalk sea was raised up, and remained dry land, until it was covered with forest, stocked with the great game the spoils of which have rejoiced your geologists. How long it remained in that condition cannot be said; but, "the whirligig of time brought its revenges" in those days as in these. That dry land, with the bones and teeth of generations of long-lived elephants, hidden away among the gnarled roots and dry leaves of its ancient trees, sank gradually to the bottom of the icy sea, which covered it with huge masses of drift and boulder clay. Sea-beasts, such as the walrus now restricted to the extreme north, paddled about where birds had twittered among the topmost twigs of the fir-trees. How long this state of things endured we know not, but at length it came to an end. The upheaved glacial mud hardened into the soil of modern Norfolk. Forests grew once more, the wolf and the beaver replaced the reindeer and the elephant; and at length what we call the history of England dawned.

Thus you have, within the limits of your own [28] county, proof that the chalk can justly claim a very much greater antiquity than even the oldest physical traces of mankind. But we may go further and demonstrate, by evidence of the same authority as that which testifies to the existence of the father of men, that the chalk is vastly older than Adam himself. The Book of Genesis informs us that Adam, immediately upon his creation, and before the appearance of Eve, was placed in the Garden of Eden. The problem of the geographical position of Eden has greatly vexed the spirits of the learned in such matters, but there is one point respecting which, so far as I know, no commentator has ever raised a doubt. This is, that of the four rivers which are said to run out of it, Euphrates and Hiddekel are identical with the rivers now known by the names of Euphrates and Tigris. But the whole country in which these mighty rivers take their origin, and through which they run, is composed of rocks which are either of the same age as the chalk, or of later date. So that the chalk must not only have been formed, but, after its formation, the time required for the deposit of these later rocks, and for their upheaval into dry land, must have elapsed, before the smallest brook which feeds the swift stream of "the great river, the river of Babylon" began to flow.

Thus, evidence which cannot be rebutted, and which need not be strengthened, though if time [29] permitted I might indefinitely increase its quantity, compels you to believe that the earth, from the time of the chalk to the present day, has been the theatre of a series of changes as vast in their amount, as they were slow in their progress. The area on which we stand has been first sea and then land, for at least four alternations; and has remained in each of these conditions for a period of great length.

Nor have these wonderful metamorphoses of sea into land, and of land into sea, been confined to one corner of England. During the chalk period, or "cretaceous epoch," not one of the present great physical features of the globe was in existence. Our great mountain ranges, Pyrenees, Alps, Himalayas, Andes, have all been upheaved since the chalk was deposited, and the cretaceous sea flowed over the sites of Sinai and Ararat. All this is certain, because rocks of cretaceous, or still later, date have shared in the elevatory movements which gave rise to these mountain chains; and may be found perched up, in some cases, many thousand feet high upon their flanks. And evidence of equal cogency demonstrates that, though, in Norfolk, the forest-bed rests directly upon the chalk, yet it does so, not because the period at which the forest grew immediately followed that at which the chalk was formed, but because an immense lapse of time, represented elsewhere by thousands of feet of rock, is not indicated at Cromer.

[30] I must ask you to believe that there is no less conclusive proof that a still more prolonged succession of similar changes occurred, before the chalk was deposited. Nor have we any reason to think that the first term in the series of these changes is known. The oldest sea-beds preserved to us are sands, and mud, and pebbles, the wear and tear of rocks which were formed in still older oceans.

But, great as is the magnitude of these physical changes of the world, they have been accompanied by a no less striking series of modifications in its living inhabitants. All the great classes of animals, beasts of the field, fowls of the air, creeping things, and things which dwell in the waters, flourished upon the globe long ages before the chalk was deposited. Very few, however, if any, of these ancient forms of animal life were identical with those which now live. Certainly not one of the higher animals was of the same species as any of those now in existence. The beasts of the field, in the days before the chalk, were

not our beasts of the field, nor the fowls of the air such as those which the eye of man has seen flying, unless his antiquity dates infinitely further back than we at present surmise. If we could be carried back into those times, we should be as one suddenly set down in Australia before it was colonized. We should see mammals, birds, reptiles, fishes, insects, snails, and the like, clearly [31] recognizable as such, and yet not one of them would be just the same as those with which we are familiar, and many would be extremely different.

From that time to the present, the population of the world has undergone slow and gradual, but incessant, changes. There has been no grand catastrophe–no destroyer has swept away the forms of life of one period, and replaced them by a totally new creation: but one species has vanished and another has taken its place; creatures of one type of structure have diminished, those of another have increased, as time has passed on. And thus, while the differences between the living creatures of the time before the chalk and those of the present day appear startling, if placed side by side, we are led from one to the other by the most gradual progress, if we follow the course of Nature through the whole series of those relics of her operations which she has left behind. It is by the population of the chalk sea that the ancient and the modern inhabitants of the world are most completely connected. The groups which are dying out flourish, side by side, with the groups which are now the dominant forms of life. Thus the chalk contains remains of those strange flying and swimming reptiles, the pterodactyl, the ichthyosaurus and the plesiosaurus, which are found in no later deposits, but abounded in preceding ages. The [32] chambered shells called ammonites and belemnites, which are so characteristic of the period preceding the cretaceous, in like manner die with it.

But, amongst these fading remainders of a previous state of things, are some very modern forms of life, looking like Yankee pedlars among a tribe of Red Indians. Crocodiles of modern type appear; bony fishes, many of them very similar to existing species, almost supplant the forms of fish which predominate in more ancient seas; and many kinds of living shellfish first become known to us in the chalk. The vegetation acquires a modern aspect. A few living animals are not even distinguishable as species, from those which existed at that remote epoch. The *Globigerina* of the present day, for example, is not different specifically from that of the chalk; and the same may be said of many other *Foraminifera.* I think it probable that critical and unprejudiced examination will show that more than one species of much higher animals have had a similar longevity; but the only example which I can at present give confidently is the snake's-head lamp-shell *(Terebratulina caput serpentis),* which lives in our English seas and abounded (as *Terebratulina striata* of authors) in the chalk.

The longest line of human ancestry must hide its diminished head before the pedigree of this insignificant shellfish. We Englishmen are proud to have an ancestor who was present at the [33] Battle of Hastings. The ancestors of *Terebratulina caput serpentis* may have been present at a battle of *Ichthyosauria* in that part of the sea which, when the chalk was forming, flowed over the site of Hastings. When all around has changed, this *Terebratulina* has peacefully propagated its species from generation to generation, and stands to this day, as a living testimony to the continuity of the present with the past history of the globe.

Up to this moment I have stated, so far as I know, nothing but well-authenticated facts, and the immediate conclusions which they force upon the mind. But the mind is so constituted that it does not willingly rest in facts and immediate causes, but seeks always after a knowledge of the remoter links in the chain of causation.

Taking the many changes of any given spot of the earth's surface, from sea to land and from land to sea, as an established fact, we cannot refrain from asking ourselves how these changes have occurred. And when we have explained them–as they must be explained–by the alternate slow movements of elevation and depression which have affected the crust of the earth, we go still further back, and ask, Why these movements?

I am not certain that any one can give you a satisfactory answer to that question. Assuredly I cannot. All that can be said, for certain, is, that such movements are part of the ordinary course [34] of nature, inasmuch as they are going on at the present time. Direct proof may be given, that some parts of the land of the northern hemisphere are at this moment insensibly rising and others insensibly sinking; and there is indirect, but perfectly satisfactory, proof, that an enormous area now covered by the Pacific has been deepened thousands of feet, since the present inhabitants of that sea came into existence. Thus there is not a shadow of a reason for believing that the physical changes of the globe, in past times, have been affected by other than natural causes. Is there any more reason for believing that the concomitant modifications in the forms of the living inhabitants of the globe have been brought about in other ways?

Before attempting to answer this question, let us try to form a distinct mental picture of what has happened in some special case. The crocodiles are animals which, as a group, have a very vast antiquity. They abounded ages before the chalk was deposited; they throng the rivers in warm climates, at the present day. There is a difference in the form of the joints of the back-bone, and in some minor particulars, between the crocodiles of the present epoch and those which lived before the chalk; but, in the cretaceous epoch, as I have already mentioned, the crocodiles had assumed the modern type of structure. Notwithstanding this, the crocodiles of the chalk are not [35] identically the same as those which lived in the times called "older tertiary," which succeeded the cretaceous epoch; and the crocodiles of the older tertiaries are not identical with those of the newer tertiaries, nor are these identical with existing forms. I leave open the question whether particular species may have lived on from epoch to epoch. But each epoch has had its peculiar crocodiles; though all, since the chalk, have belonged to the modern type, and differ simply in their proportions, and in such structural particulars as are discernible only to trained eyes.

How is the existence of this long succession of different species of crocodiles to be accounted for? Only two suppositions seem to be open to us–Either each species of crocodile has been specially created, or it has arisen out of some pre-existing form by the operation of natural causes. Choose your hypothesis; I have chosen mine. I can find no warranty for believing in the distinct creation of a score of successive species of crocodiles in the course of countless ages of time. Science gives no countenance to such a wild fancy; nor can even the perverse ingenuity of a commentator pretend to discover this sense, in the simple words in which the writer of Genesis records the proceedings of the fifth and sixth days of the Creation.

On the other hand, I see no good reason for doubting the necessary alternative, that all these varied species have been evolved from pre-existing [36] crocodilian forms, by the operation of causes as completely a part of the common order of nature as those which have effected the changes of the inorganic world. Few will venture to affirm that the reasoning which applies to crocodiles loses its force among other animals, or among plants. If one series of species has come into existence by the operation of natural causes, it seems folly to deny that all may have arisen in the same way.

A small beginning has led us to a great ending. If I were to put the bit of chalk with which we started into the hot but obscure flame of burning hydrogen, it would presently shine like the sun. It seems to me that this physical metamorphosis is no false image of what has been the result of our subjecting it to a jet of fervent, though nowise brilliant, thought to-night. It has become luminous, and its clear rays, penetrating the abyss of the remote past, have brought within our ken some stages of the evolution of the earth. And in the shifting "without haste, but without rest" of the land and sea, as in the endless variation of the forms assumed by living beings, we have observed nothing but the natural product of the forces originally possessed by the substance of the universe.

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[1] See Appendix to Captain Dayman's *Deep-sea Soundings in the North Atlantic Ocean between Ireland and Newfoundland, made in H.M.S. "Cyclops."* Published by order of the Lords Commissioners of the Admiralty, 1858. They have since formed the subject of an elaborate Memoir by Messrs. Parker and Jones, published in the *Philosophical Transactions* for 1865.

[2] During the cruise of H.M.S. *Bulldog,* commanded by Sir Leopold McClintock, in 1860, living star-fish were brought up, clinging to the lowest part of the sounding-line, from a depth of 1,260 fathoms, midway between Cape Farewell, in Greenland, and the Rockall banks. Dr. Wallich ascertained that the sea-bottom at this point consisted of the ordinary *Globigerina* ooze, and that the stomachs of the star-fishes were full of *Globigerinæ.* This discovery removes all objections to the existence of living *Globigerinæ* at great depths, which are based upon the supposed difficulty of maintaining animal life under such conditions; and it throws the burden of proof upon those who object to the supposition that the *Globigerinæ* live and die where they are found.

[3] I have recently traced out the development of the "coccoliths" from a diameter of l/7000th of an inch up to their largest size (which is about 1/6000th), and no longer doubt that they are produced by independent organisms, which, like the *Globigerinæ,* live and die at the bottom of the sea.

[4] *Elements of Geology,* by Sir Charles Lyell, Bart., F.R.S., p. 23.

Lighthouse Doodle

Huxley Archives

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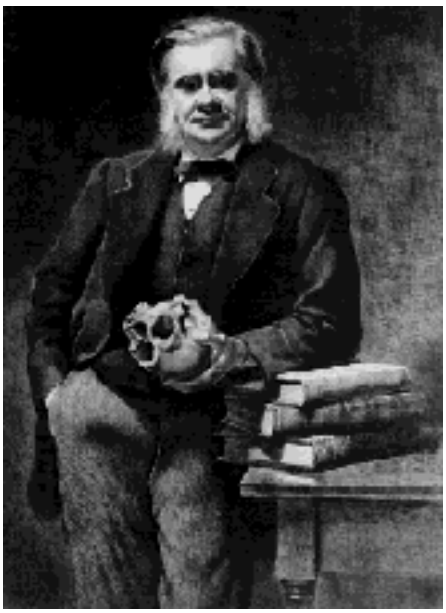

Preface and Table of Contents to Volume VII, *Discourses: Biological & Geological,* of Huxley's *Collected Essays.*

Next article: The Problems of the Deep Sea [1873], pages 37-68.

The Problems of The Deep Sea

The Contemporary Review (1873)

Collected Essays VIII

[37] On the 21st of December, 1872, H.M.S. *Challenger*, an eighteen gun corvette, of 2,000 tons burden, sailed from Portsmouth harbour for a three, or perhaps four, years' cruise. No man-of-war ever left that famous port before with so singular an equipment. Two of the eighteen sixty-eight pounders of the *Challenger's* armament remained to enable her to speak with effect to sea-rovers, haply devoid of any respect for science, in the remote seas for which she is bound; but the main-deck was, for the most part, stripped of its war-like gear, and fitted up with physical, chemical, and biological laboratories; photography had its dark cabin; while apparatus for dredging, trawling, and sounding; for photometers and for thermometers, filled the space formerly occupied by guns and gun-tackle, pistols and cutlasses.

[38] The crew of the *Challenger* match her fittings. Captain Nares, his officers and men, are ready to look after the interests of hydrography, work the ship, and, if need be, fight her as seamen should; while there is a staff of scientific civilians, under the general direction of Dr. Wyville Thomson, F.R.S. (Professor of Natural History in Edinburgh University by rights, but at present detached for duty *in partibus*), whose business it is to turn all the wonderfully packed stores of appliances to account, and to accumulate, before the ship returns to England, such additions to natural knowledge as shall justify the labour and cost involved in the fitting out and maintenance of the expedition.

Under the able and zealous superintendence of the Hydrographer, Admiral Richards, every precaution which experience and forethought could devise has been taken to provide the expedition with the material conditions of success; and it would seem as if nothing short of wreck or pestilence, both most improbable contingencies, could prevent the *Challenger* from doing splendid work, and opening up a new era in the history of scientific voyages.

The despatch of this expedition is the culmination of a series of such enterprises, gradually increasing in magnitude and importance, which the Admiralty, greatly to its credit, has carried out for some years past; and the history of which is given by Dr. Wyville Thomson in the beautifully illus[39]trated volume entitled "The Depths of the Sea," published since his departure.

"In the spring of the year 1868, my friend Dr. W. B. Carpenter, at that time one of the Vice-Presidents of the Royal Society, was with me in Ireland, where we were working out together the structure and development of the Crinoids. I had long previously had a profound conviction that the land of promise for the naturalist, the only remaining region where there were endless novelties of extraordinary interest ready to the hand which had the means of gathering them, was the bottom of the deep sea. I had even had a glimpse of some of these treasures, for I had seen, the year before, with Prof. Sars, the forms which I have already mentioned dredged by his son at a depth of 300 to 400 fathoms off the Loffoten Islands. I propounded my views to my fellow-labourer, and we discussed the subject many times over our microscopes. I strongly urged Dr. Carpenter to use his influence at

head-quarters to induce the Admiralty, probably through the Council of the Royal Society, to give us the use of a vessel properly fitted with dredging gear and all necessary scientific apparatus, that many heavy questions as to the state of things in the depths of the ocean, which were still in a state of uncertainty, might be definitely settled. After full consideration, Dr. Carpenter promised his hearty cooperation, and we agreed that I should write to him on his return to London, indicating generally the results which I anticipated, and sketching out what I conceived to be a promising line of inquiry. The Council of the Royal Society warmly supported the proposal; and I give here in chronological order the short and eminently satisfactory correspondence which led to the Admiralty placing at the disposal of Dr. Carpenter and myself the gunboat *Lightning*, under the command of Staff-Commander May, R.N., in the summer of 1868, for a trial cruise to the North of Scotland, and afterwards to the much wider surveys in H.M.S. *Porcupine*, Captain Calver, R.N., which were made with the additional association of Mr. Gwyn Jeffreys, in the summers of the years 1869 and 1870."[1]

[40] Plain men may be puzzled to understand why Dr. Wyville Thomson, not being a cynic, should relegate the "Land of Promise" to the bottom of the deep sea; they may still more wonder what manner of "milk and honey" the *Challenger* expects to find; and their perplexity may well rise to its maximum, when they seek to divine the manner in which that milk and honey are to be got out of so inaccessible a Canaan. I will, therefore, endeavour to give some answer to these questions in an order the reverse of that in which I have stated them.

Apart from hooks, and lines, and ordinary nets, fishermen have, from time immemorial, made use of two kinds of implements for getting at sea-creatures which live beyond tidemarks–these are the "dredge" and the "trawl." The dredge is used by oyster-fishermen. Imagine a large bag, the mouth of which has the shape of an elongated parallelogram, and is fastened to an iron frame of the same shape, the two long sides of this rim being fashioned into scrapers. Chains attach the ends of the frame to a stout rope, so that when the bag is dragged along by the rope the edge of one of the scrapers rests on the ground, and scrapes whatever it touches into the bag. The oyster-dredger takes one of these machines in his boat, and when he has reached the oyster-bed the dredge is tossed overboard; as soon as it has sunk to the bottom the rope is paid out sufficiently [41] to prevent it from pulling the dredge directly upwards, and is then made fast while the boat goes ahead. The dredge is thus dragged along and scrapes oysters and other sea-animals and plants, stones, and mud into the bag. When the dredger judges it to be full he hauls it up, picks out the oysters, throws the rest overboard, and begins again.

Dredging in shallow water, say ten to twenty fathoms, is an easy operation enough; but the deeper the dredger goes, the heavier must be his vessel, and the stouter his tackle, while the operation of hauling up becomes more and more laborious. Dredging in 150 fathoms is very hard work, if it has to be carried on by manual labour; but by the use of the donkey-engine to supply power,[2] and of the contrivances known as "accumulators," to diminish the risk of snapping the dredge rope by the rolling and pitching of the vessel, the dredge has been worked deeper and deeper, until at last, on the 22nd of July, 1869, H.M.S. Porcupine being in the Bay of Biscay, Captain Calver, her commander, performed the unprecedented feat of dredging in 2,435 fathoms, or 14,610 feet, a depth [42] nearly equal to the height of Mont Blanc. The dredge "was rapidly hauled on deck at one o'clock in the morning of the 23rd, after an absence of 7-1/4 hours, and a journey of upwards of eight statute miles," with a hundred weight and a half of solid contents.

The trawl is a sort of net for catching those fish which habitually live at the bottom of the sea, such as soles, plaice, turbot, and gurnett. The mouth of the net may be thirty or forty feet wide, and one edge of its mouth is fastened to a beam of wood of the same length. The two ends of the beam are supported by curved pieces of iron, which raise the beam and the edge of the net which is fastened to it, for a short distance, while the other edge of the mouth of the net trails upon the ground. The closed end of the net has the form of a great pouch; and, as the beam is dragged along, the fish, roused from the bottom by the sweeping of the net, readily pass into its mouth and accumulate in the pouch at its end. After drifting with the tide for six or seven hours the trawl is hauled up, the marketable fish are picked out, the others thrown away, and the trawl sent overboard for another operation.

More than a thousand sail of well-found trawlers are constantly engaged in sweeping the seas around our coast in this way, and it is to them that we owe a very large proportion of our supply of fish. The difficulty of trawling, like that of [43] dredging, rapidly increases with the depth at which the operation is performed; and, until the other day, it is probable that trawling at so great a depth as 100 fathoms was something unheard of. But the first news from the *Challenger* opens up new possibilities for the trawl.

Dr. Wyville Thomson writes ("Nature," March 20, 1873):–

"For the fist two or three hauls in very deep water off the coast of Portugal, the dredge came up filled with the usual 'Atlantic ooze,' tenacious and uniform throughout, and the work of hours, in sifting, gave the very smallest possible result. We were extremely anxious to get some idea of the general character of the Fauna, and particularly of the distribution of the higher groups, and after various suggestions for modification of the dredge, it was proposed to try the ordinary trawl. We had a compact trawl, with a 15-feet beam, on board, and we sent it down off Cape St. Vincent at a depth of 600 fathoms. The experiment looked hazardous, but, to our great satisfaction, the trawl came up all right and contained, with many of the larger invertebrata, several fishes.... After the first attempt we tried the trawl several times at depths of 1090, 1525, and, finally, 2125 fathoms, and always with success."

To the coral-fishers of the Mediterranean, who seek the precious red coral, which grows firmly fixed to rocks at a depth of sixty to eighty fathoms, both the dredge and the trawl would be useless. They, therefore, have recourse to a sort of frame, to which are fastened long bundles of loosely netted hempen cord, and which is lowered by a rope to the depth at which the hempen cords can sweep over the surface of the rocks and break [44] off the coral, which is brought up entangled in the cords. A similar contrivance has arisen out of the necessities of deep-sea exploration.

In the course of the dredging of the *Porcupine,* it was frequently found that, while few objects of interest were brought up within the dredge, many living creatures came up sticking to the outside of the dredge-bag, and even to the first few fathoms of the dredge-rope. The mouth of the dredge doubtless rapidly filled with mud, and thus the things it should have brought up were shut out. To remedy this inconvenience Captain Calver devised an arrangement not unlike that employed by the coral-fishers. He fastened half a dozen swabs, such as are used for drying decks, to the dredge. A swab is something like what a birch-broom would be if its twigs were made of long, coarse, hempen yarns. These dragged along

after the dredge over the surface of the mud, and entangled the creatures living there–multitudes of which, twisted up in the strands of the swabs, were brought to the surface with the dredge. A further improvement was made by attaching a long iron bar to the bottom of the dredge bag, and fastening large bunches of teased-out hemp to the end of this bar. These "tangles" bring up immense quantities of such animals as have long arms, or spines, or prominences which readily become caught in the hemp, but they are very destructive to the fragile organisms which they [45] imprison; and, now that the trawl can be successfully worked at the greatest depths, it may be expected to supersede them; at least, wherever the ground is soft enough to permit of trawling.

It is obvious that between the dredge, the trawl, and the tangles, there is little chance for any organism, except such as are able to burrow rapidly, to remain safely at the bottom of any part of the sea which the *Challenger* undertakes to explore. And, for the first time in the history of scientific exploration, we have a fair chance of learning what the population of the depths of the sea is like in the most widely different parts of the world.

And now arises the next question. The means of exploration being fairly adequate, what forms of life may be looked for at these vast depths?

The systematic study of the Distribution of living beings is the most modern branch of Biological Science, and came into existence long after Morphology and Physiology had attained a considerable development. This naturally does not imply that, from the time men began to observe natural phenomena, they were ignorant of the fact that the animals and plants of one part of the world are different from those in other regions; or that those of the hills are different from those of the plains in the same region; or finally that some marine creatures are found only in the shallows, while others inhabit the deeps. Nevertheless, it was only after the discovery of America [46] that the attention of naturalists was powerfully drawn to the wonderful differences between the animal population of the central and southern parts of the new world and that of those parts of the old world which lie under the same parallels of latitude. So far back as 1667 Abraham Mylius, in his treatise "De Animalium origine et migratione populorum," argues that, since there are innumerable species of animals in America which do not exist elsewhere, they must have been made and placed there by the Deity: Buffon no less forcibly insists upon the difference between the Faunæ of the old and new world. But the first attempt to gather facts of this order into a whole, and to coordinate them into a series of generalizations, or laws of Geographical Distribution, is not a century old, and is contained in the "Specimen Zoologiæ Geographicæ Quadrupedum Domicilia et Migrationes sistens," published, in 1777, by the learned Brunswick Professor, Eberhard Zimmermann, who illustrates his work by what he calls a "Tabula Zoographica," which is the oldest distributional map known to me.

In regard to matters of fact, Zimmermann's chief aim is to show that among terrestrial mammals, some occur all over the world, while others are restricted to particular areas of greater or smaller extent; and that the abundance of species follows temperature, being greatest in warm and least in cold climates. But marine animals, [47] he thinks, obey no such law. The Arctic and Atlantic seas, he says, are as full of fishes and other animals as those of the tropics. It is, therefore, clear that cold does not affect the dwellers in the sea as it does land animals, and that this must be the case follows from the fact that sea

water, "propter varias quas continet bituminis spiritusque particulas," freezes with much more difficulty than fresh water. On the other hand, the heat of the Equatorial sun penetrates but a short distance below the surface of the ocean. Moreover, according to Zimmermann, the incessant disturbance of the mass of the sea by winds and tides, so mixes up the warm and the cold that life is evenly diffused and abundant throughout the ocean.

In 1810, Risso, in his work on the Ichthyology of Nice, laid the foundation of what has since been termed "bathymetrical" distribution, or distribution in depth, by showing that regions of the sea bottom of different depths could be distinguished by the fishes which inhabit them. There was the *littoral region* between tide marks with its sand-eels, pipe fishes, and blennies: the *seaweed region,* extending from lowwater-mark to a depth of 450 feet, with its wrasses, rays, and flat fish; and the *deep-sea region*, from 450 feet to 1500 feet or more, with its file-fish, sharks, gurnards, cod, and swordfish.

More than twenty years later, MM. Audouin and [48] Milne Edwards carried out the principle of distinguishing the Faunæ of different zones of depth much more minutely, in their "Recherches pour servir à l'Histoire Naturelle du Littoral de la France," published in 1832.

They divide the area included between highwater-mark and lowwater-mark of spring tides (which is very extensive, on account of the great rise and fall of the tide on the Normandy coast about St. Malo, where their observations were made) into four zones, each characterized by its peculiar invertebrate inhabitants. Beyond the fourth region they distinguish a fifth, which is never uncovered, and is inhabited by oysters, scallops, and large starfishes and other animals. Beyond this they seem to think that animal life is absent.[3]

Audouin and Milne Edwards were the first to see the importance of the bearing of a knowledge of the manner in which marine animals are distributed in depth, on geology. They suggest that, by this means, it will be possible to judge whether a fossiliferous stratum was formed upon the shore of an ancient sea, and even to determine whether it was deposited in shallower or deeper water on that shore; the association of shells of animals which live in different zones of depth will [49] prove that the shells have been transported into the position in which they are found; while, on the other hand, the absence of shells in a deposit will not justify the conclusion that the waters in which it was formed were devoid of animal inhabitants, inasmuch as they might have been only too deep for habitation.

The new line of investigation thus opened by the French naturalists was followed up by the Norwegian, Sars, in 1835, by Edward Forbes, in our own country, in 1840,[4] and by Œrsted, in Denmark, a few years later. The genius of Forbes, combined with his extensive knowledge of botany, invertebrate zoology, and geology, enabled him to do more than any of his compeers, in bringing the importance of distribution in depth into notice; and his researches in the Ægean Sea, and still more his remarkable paper "On the Geological Relations of the existing Fauna and Flora of the British Isles," published in 1846, in the first volume of the "Memoirs of the Geological Survey of Great Britain," attracted universal attention.

On the coasts of the British Islands, Forbes distinguishes four zones or regions, the Littoral (between tide marks), the Laminarian (between lowwater-mark and 15 fathoms), the Coralline (from 15 to 50 fathoms), and the Deep sea or Coral region (from 50 fathoms to beyond 100 fathoms). But, in the deeper waters of the Ægean Sea, [50] between the shore and a depth of 300 fathoms, Forbes was able to make out no fewer than eight zones of life, in the course of which the number and variety of forms gradually diminished; until, beyond 300 fathoms, life disappeared altogether. Hence it appeared as if descent in the sea had much the same effect on life, as ascent on land. Recent investigations appear to show that Forbes was right enough in his classification of the facts of distribution in depth as they are to be observed in the Ægean; and though, at the time he wrote, one or two observations were extant which might have warned him not to generalize too extensively from his Ægean experience, his own dredging work was so much more extensive and systematic than that of any other naturalist, that it is not wonderful he should have felt justified in building upon it. Nevertheless, so far as the limit of the range of life in depth goes, Forbes' conclusion has been completely negatived, and the greatest depths yet attained show not even an approach to a "zero of life":–

"During the several cruises of H.M. ships *Lightning* and *Porcupine* in the years 1868, 1869, and 1870," says Dr. Wyville Thomson, "fifty-seven hauls of the dredge were taken in the Atlantic at depths beyond 500 fathoms and sixteen at depths beyond 1,000 fathoms, and, in all cases life was abundant. In 1869, we took two casts in depths greater than 2,000 fathoms. In both of these life was abundant; and with the deepest cast, 2,435 fathoms, off the mouth of the Bay of Biscay we took living, well-marked and characteristic examples of all the five invertebrate sub-kingdoms. And thus the question of the existence of abundant animal life at the bottom of the sea has been finally settled and for all depths, for there is no reason to suppose that the depth anywhere exceeds between three and four thousand fathoms; and if there be nothing in the conditions of a depth of 2,500 fathoms to prevent the full development of a varied Fauna, it is impossible to suppose that even an additional thousand fathoms would make any great difference."[5]

As Dr. Wyville Thomson's recent letter, cited above, shows, the use of the trawl, at great depths, has brought to light a still greater diversity of life. Fishes came up from a depth of 600 to more than [52] 1,000 fathoms, all "in a peculiar condition from the expansion of the air contained in their bodies. On their relief from the extreme pressure, their eyes, especially, had a singular appearance, protruding like great globes from their heads." Bivalve and univalve mollusca seem to be rare at the greatest depths; but starfishes, sea urchins, and other echinoderms, zoophytes, sponges, and protozoa abound.

It is obvious that the *Challenger* has the privilege of opening a new chapter in the history of the living world. She cannot send down her dredges and her trawls into these virgin depths of the great ocean without bringing up a discovery. Even though the thing itself may be neither "rich nor rare," the fact that it came from that depth, in that particular latitude and longitude, will be a new fact in distribution, and, as such, have a certain importance.

But it may be confidently assumed that the things brought up will very frequently be zoological novelties; or, better still, zoological antiquities, which, in the tranquil and little-changed depths of the ocean, have escaped the causes of destruction at work in the shallows, and represent the predominant population of a past age.

It has been seen that Audouin and Milne Edwards foresaw the general influence of the study of distribution in depth upon the interpreta[53]tion of geological phenomena. Forbes connected the two orders of inquiry still more closely; and in the thoughtful essay "On the connection between the distribution of the existing Fauna and Flora of the British Isles, and the geological changes which have affected their area, especially during the epoch of the Northern drift," to which reference has already been made, he put forth a most pregnant suggestion.

In certain parts of the sea bottom in the immediate vicinity of the British Islands, as in the Clyde district, among the Hebrides, in the Moray Firth, and in the German Ocean, there are depressed areæ, forming a kind of submarine valleys, the centres of which are from 80 to 100 fathoms, or more, deep. These depressions are inhabited by assemblages of marine animals, which differ from those found over the adjacent and shallower region, and resemble those which are met with much farther north, on the Norwegian coast. Forbes called these Scandinavian detachments "Northern outliers."

How did these isolated patches of a northern population get into these deep places? To explain the mystery, Forbes called to mind the fact that, in the epoch which immediately preceded the present, the climate was much colder (whence the name of "glacial epoch" applied to it); and that the shells which are found fossil, or sub-fossil, in deposits of that age are precisely such [54] as are now to be met with only in the Scandinavian, or still more Arctic, regions. Undoubtedly, during the glacial epoch, the general population of our seas had, universally, the northern aspect which is now presented only by the "northern outliers"; just as the vegetation of the land, down to the sea-level, had the northern character which is, at present, exhibited only by the plants which live on the tops of our mountains. But, as the glacial epoch passed away, and the present climatal conditions were developed, the northern plants were able to maintain themselves only on the bleak heights, on which southern forms could not compete with them. And, in like manner, Forbes suggested that, after the glacial epoch, the northern animals then inhabiting the sea became restricted to the deeps in which they could hold their own against invaders from the south, better fitted than they to flourish in the warmer waters of the shallows. Thus depth in the sea corresponded in its effect upon distribution to height on the land.

The same idea is applied to the explanation of a similar anomaly in the Fauna of the *Æ*gean:–

"In the deepest of the regions of depth of the *Æ*gean, the representation of a Northern Fauna is maintained, partly by identical and partly by representative forms. ... The presence of the latter is essentially due to the law (of representation of parallels of latitude by zones of depth), whilst that of the former species depended on their transmission from their parent seas during a former epoch, and subsequent isolation. That [55] epoch was doubtless the newer Pliocene or Glacial Era, when the *Mya truncata* and other northern forms now extinct in the Mediterranean, and found fossil in the Sicilian tertiaries, ranged into that sea. The changes which there destroyed the *shallow water* glacial forms, did not affect those living in the depths, and which still survive."[6]

The conception that the inhabitants of local depressions of the sea bottom might be a remnant of the ancient population of the area, which had held their own in these deep fastnesses against an invading Fauna, as Britons and Gaels have held out in Wales and in Scotland against encroaching Teutons, thus

broached by Forbes, received a wider application than Forbes had dreamed of when the sounding machine first brought up specimens of the mud of the deep sea. As I have pointed out elsewhere,[7] it at once became obvious that the calcareous sticky mud of the Atlantic was made up, in the main, of shells of *Globigerina* and other *Foraminifera,* identical with those of which the true chalk is composed, and the identity extended even to the presence of those singular bodies, the Coccoliths and Coccospheres, the true nature of which is not yet made out. Here then were organisms, as old as the cretaceous epoch, still alive, and doing their work of rock-making at the bottom of existing seas. What if *Globigerina* [56] and the Coccoliths should not be the only survivors of a world passed away, which are hidden beneath three miles of salt water? The letter which Dr. Wyville Thomson wrote to Dr. Carpenter in May, 1868, out of which all these expeditions have grown, shows that this query had become a practical problem in Dr. Thomson's mind at that time; and the desirableness of solving the problem is put in the foreground of his reasons for urging the Government to undertake the work of exploration:–

"Two years ago, M. Sars, Swedish Government Inspector of Fisheries, had an opportunity, in his official capacity, of dredging off the Loffoten Islands at a depth of 300 fathoms. I visited Norway shortly after his return, and had an opportunity of studying with his father, Professor Sars, some of his results. Animal forms were *abundant;* many of them were new to science; and among them was one of surpassing interest, the small crinoid, of which you have a specimen, and which we at once recognized as a degraded type of the *Apiocrinidæ,* an order hitherto regarded as extinct, which attained its maximum in the Pear Encrinites of the Jurassic period, and whose latest representative hitherto known was the *Bourquettocrinus* of the chalk. Some years previously, Mr. Absjornsen, dredging in 200 fathoms in the Hardangerfjord, procured several examples of a Starfish (*Brisinga*), which seems to find its nearest ally in the fossil genus *Protaster.* These observations place it beyond a doubt that animal life is abundant in the ocean at depths varying from 200 to 300 fathoms, that the forms at these great depths differ greatly from those met with in ordinary dredgings, and that, at all events in some cases, these animals are closely allied to, and would seem to be directly descended from, the Fauna of the early tertiaries.

"I think the latter result might almost have been antici[57]pated; and, probably, further investigation will largely add to this class of data, and will give us an opportunity of testing our determinations of the zoological position of some fossil types by an examination of the soft parts of their recent representatives The main cause of the destruction, the migration, and the extreme modification of animal types, appear to be change of climate, chiefly depending upon oscillations of the earth's crust. These oscillations do not appear to have ranged, in the Northern portion of the Northern Hemisphere, much beyond 1,000 feet since the commencement of the Tertiary Epoch. The temperature of deep waters seems to be constant for all latitudes at 39° so that an immense area of the North Atlantic must have had its conditions unaffected by tertiary or post-tertiary oscillations."[8]

As we shall see, the assumption that the temperature of the deep sea is everywhere 39° F. (4° Cent.) is an error, which Dr. Wyville Thomson adopted from eminent physical writers; but the general justice of the reasoning is not affected by this circumstance, and Dr. Thomson's expectation has been, to some extent, already verified.

Thus besides *Globigerina,* there are eighteen species of deep-sea *Foraminifera* identical with species found in the chalk. Embedded in the chalky mud of the deep sea, in many localities, are innumerable cup-shaped sponges, provided with six-rayed silicious spicula, so disposed that the wall of the cup is formed of a lacework of flinty thread. Not less abundant, in some parts of the chalk formation, are the

fossils known as *Ventriculites*, well described by [58] Dr. Thomson as "elegant vases or cups, with branching root-like bases, or groups of regularly or irregularly spreading tubes delicately fretted on the surface with an impressed network like the finest lace"; and he adds, "When we compare such recent forms as *Aphrocallistes, Iphiteon, Holtenia,* and *Askonema,* with certain series of the chalk *Ventricu1ites,* there cannot be the slightest doubt that they belong to the same family–in some cases to very nearly allied genera."[9]

Professor Duncan finds "several corals from the coast of Portugal more nearly allied to chalk forms than to any others."

The Stalked Crinoids or Feather Stars, so abundant in ancient times, are now exclusively confined to the deep sea, and the late explorations have yielded forms of old affinity, the existence of which has hitherto been unsuspected. The general character of the group of star fishes imbedded in the white chalk is almost the same as in the modern Fauna of the deep Atlantic. The sea urchins of the deep sea, while none of them are specifically identical with any chalk form, belong to the same general groups, and some closely approach extinct cretaceous genera.

Taking these facts in conjunction with the positive evidence of the existence, during the Cretaceous epoch, of a deep ocean where now lies the dry land of central and southern Europe, [59] northern Africa, and western and southern Asia; and of the gradual diminution of this ocean during the older tertiary epoch, until it is represented at the present day by such teacup-fuls as the Caspian, the Black Sea, and the Mediterranean; the supposition of Dr. Thomson and Dr. Carpenter that what is now the deep Atlantic, was the deep Atlantic (though merged in a vast easterly extension) in the Cretaceous epoch, and that the *Globigerina* mud has been accumulating there from that time to this, seems to me to have a great degree of probability. And I agree with Dr. Wyville Thomson against Sir Charles Lyell (it takes two of us to have any chance against his authority) in demurring to the assertion that "to talk of chalk having been uninterruptedly formed in the Atlantic is as inadmissible in a geographical as in a geological sense."

If the word "chalk" is to be used as a stratigraphical term and restricted to *Globigerina* mud deposited during the Cretaceous epoch, of course it is improper to call the precisely similar mud of more recent date, chalk. If, on the other hand, it is to be used as a mineralogical term, I do not see how the modern and the ancient chalks are to be separated–and, looking at the matter geographically, I see no reason to doubt that a boring rod driven from the surface of the mud which forms the floor of the mid-Atlantic [60] would pass through one continuous mass of *Globigerina* mud, first of modern, then of tertiary, and then of mesozoic date; the "chalks" of different depths and ages being distinguished merely by the different forms of other organisms associated with the *Globigerinæ*.

On the other hand, I think it must be admitted that a belief in the continuity of the modern with the ancient chalk has nothing to do with the proposition that we can, in any sense whatever, be said to be still living in the Cretaceous epoch. When the *Challenger's* trawl brings up an *Ichthyosaurus,* along with a few living specimens of *Belemnites* and *Turrilites,* it may be admitted that she has come upon a

cretaceous "outlier." A geological period is characterized not only by the presence of those creatures which lived in it, but by the absence of those which have only come into existence later; and, however large a proportion of true cretaceous forms may be discovered in the deep sea, the modern types associated with them must be abolished before the Fauna, as a whole, could, with any propriety, be termed Cretaceous.

I have now indicated some of the chief lines of Biological inquiry, in which the *Challenger* has special opportunities for doing good service, and in following which she will be carrying out the work already commenced by the *Lightning* and [61] *Porcupine* in their cruises of 1868 and subsequent years.

But biology, in the long run rests upon physics, and the first condition for arriving at a sound theory of distribution in the deep sea, is the precise ascertainment of the conditions of life; or, in other words, a full knowledge of all those phenomena which are embraced under the head of the Physical Geography of the Ocean.

Excellent work has already been done in this direction, chiefly under the superintendence of Dr. Carpenter, by the *Lightning* and the *Porcupine*,[10] and some data of fundamental importance to the physical geography of the sea have been fixed beyond a doubt.

Thus, though it is true that sea-water steadily contracts as it cools down to its freezing point, instead of expanding before it reaches its freezing point as fresh water does, the truth has been steadily ignored by even the highest authorities in physical geography, and the erroneous conclusions deduced from their erroneous premises have been widely accepted as if they were ascertained facts. Of course, if sea-water, like fresh water, were heaviest at a temperature of 39° F. and got lighter as it approached 32° F., the water of the bottom of the deep sea could not be colder than 39°. But one of the first results of the careful ascertainment of the temperature [62] at different depths, by means of thermometers specially contrived for the avoidance of the errors produced by pressure, was the proof that, below 1000 fathoms in the Atlantic, down to the greatest depths yet sounded, the water has a temperature always lower than 38° Fahr., whatever be the temperature of the water at the surface. And that this low temperature of the deepest water is probably the universal rule for the depths of the open ocean is shown, among others, by Captain Chimmo's recent observations in the Indian ocean, between Ceylon and Sumatra, where, the surface water ranging from 85°–81° Fahr., the temperature at the bottom, at a depth of 2270 to 2656 fathoms, was only from 34° to 32° Fahr.

As the mean temperature of the superficial layer of the crust of the earth may be taken at about 50° Fahr., it follows that the bottom layer of the deep sea in temperate and hot latitudes, is, on the average, much colder than either of the bodies with which it is in contact; for the temperature of the earth is constant, while that of the air rarely falls so low as that of the bottom water in the latitudes in question; and even when it does, has time to affect only a comparatively thin stratum of the surface water before the return of warm weather.

How does this apparently anomalous state of things come about? If we suppose the globe to be covered

with a universal ocean, it can hardly [63] be doubted that the cold of the regions towards the poles must tend to cause the superficial water of those regions to contract and become specifically heavier. Under these circumstances, it would have no alternative but to descend and spread over the sea bottom, while its place would be taken by warmer water drawn from the adjacent regions. Thus, deep, cold, polar-equatorial currents, and superficial, warmer, equatorial-polar currents, would be set up; and as the former would have a less velocity of rotation from west to east than the regions towards which they travel, they would not be due southerly or northerly currents, but south-westerly in the northern hemisphere, and north-westerly in the southern; while, by a parity of reasoning, the equatorial-polar warm currents would be north-easterly in the northern hemisphere, and south-easterly in the southern. Hence, as a north-easterly current has the same direction as a south-westerly wind, the direction of the northern equatorial-polar current in the extra-tropical part of its course would pretty nearly coincide with that of the anti-trade winds. The freezing of the surface of the polar sea would not interfere with the movement thus set up. For, however bad a conductor of heat ice may be, the unfrozen sea-water immediately in contact with the undersurface of the ice must needs be colder than that further off; and hence will constantly tend to descend through the subjacent warmer water.

[64] In this way, it would seem inevitable that the surface waters of the northern and southern frigid zones must, sooner or later, find their way to the bottom of the rest of the ocean; and there accumulate to a thickness dependent on the rate at which they absorb heat from the crust of the earth below, and from the surface water above.

If this hypothesis be correct, it follows that, if any part of the ocean in warm latitudes is shut off from the influence of the cold polar underflow, the temperature of its deeps should be less cold than the temperature of corresponding depths in the open sea. Now, in the Mediterranean, Nature offers a remarkable experimental proof of just the kind needed. It is a landlocked sea which runs nearly east and west, between the twenty-ninth and forty-fifth parallels of north latitude. Roughly speaking, the average temperature of the air over it is 75° Fahr. in July and 48° in January.

This great expanse of water is divided by the peninsula of Italy (including Sicily), continuous with which is a submarine elevation carrying less than 1,200 feet of water, which extends from Sicily to Cape Bon in Africa, into two great pools–an eastern and a western. The eastern pool rapidly deepens to more than 12,000 feet, and sends off to the north its comparatively shallow branches, the Adriatic and the Ægean Seas. The western pool is less deep, though it reaches some 10,000 feet. And, just as the western end of the [65] eastern pool communicates by a shallow passage, not a sixth of its greatest depth, with the western pool, so the western pool is separated from the Atlantic by a ridge which runs between Capes Trafalgar and Spartel, on which there is hardly 1,000 feet of water. All the water of the Mediterranean which lies deeper than about 150 fathoms, therefore, is shut off from that of the Atlantic, and there is no communication between the cold layer of the Atlantic (below 1,000 fathoms) and the Mediterranean. Under these circumstances, what is the temperature of the Mediterranean? Everywhere below 600 feet it is about 55° Fahr.; and consequently, at its greatest depths, it is some 20° warmer than the corresponding depths of the Atlantic.

It seems extremely difficult to account for this difference in any other way, than by adopting the views

so strongly and ably advocated by Dr. Carpenter, that, in the existing distribution of land and water, such a circulation of the water of the ocean does actually occur, as theoretically must occur, in the universal ocean, with which we started.

It is quite another question, however, whether this theoretic circulation, true cause as it may be, is competent to give rise to such movements of sea-water, in mass, as those currents, which have commonly been regarded as northern extensions of the Gulfstream. I shall not venture to touch [66] upon this complicated problem; but I may take occasion to remark that the cause of a much simpler phenomenon–the stream of Atlantic water which sets through the Straits of Gibraltar, eastward, at the rate of two or three miles an hour or more, does not seem to be so clearly made out as is desirable.

The facts appear to be that the water of the Mediterranean is very slightly denser than that of the Atlantic (1.0278 to 1.0265), and that the deep water of the Mediterranean is slightly denser than that of the surface; while the deep water of the Atlantic is, if anything, lighter than that of the surface. Moreover, while a rapid superficial current is setting in (always, save in exceptionally violent easterly winds) through the Straits of Gibraltar, from the Atlantic to the Mediterranean, a deep undercurrent (together with variable side currents) is setting out through the Straits, from the Mediterranean to the Atlantic.

Dr. Carpenter adopts, without hesitation, the view that the cause of this indraught of Atlantic water is to be sought in the much more rapid evaporation which takes place from the surface of the Mediterranean than from that of the Atlantic; and thus, by lowering the level of the former, gives rise to an indraught from the latter.

But is there any sound foundation for the three assumptions involved here? Firstly, that the evaporation from the Mediterranean, as a whole, [67] is much greater than that from the Atlantic under corresponding parallels; secondly, that the rainfall over the Mediterranean makes up for evaporation less than it does over the Atlantic; and thirdly, supposing these two questions answered affirmatively: Are not these sources of loss in the Mediterranean fully covered by the prodigious quantity of fresh water which is poured into it by great rivers and submarine springs? Consider that the water of the Ebro, the Rhine, the Po, the Danube, the Don, the Dnieper, and the Nile, all flow directly or indirectly into the Mediterranean; that the volume of fresh water which they pour into it is so enormous that fresh water may sometimes be baled up from the surface of the sea off the Delta of the Nile, while the land is not yet in sight; that the water of the Black Sea is half fresh, and that a current of three or four miles an hour constantly streams from it Mediterraneanwards through the Bosphorus;–consider, in addition, that no fewer than ten submarine springs of fresh water are known to burst up in the Mediterranean, some of them so large that Admiral Smyth calls them "subterranean rivers of amazing volume and force"; and it would seem, on the face of the matter, that the sun must have enough to do to keep the level of the Mediterranean down; and that, possibly, we may have to seek for the cause of the small superiority in saline contents of the Mediterranean water in some condition other than solar evaporation.

[68] Again, if the Gibraltar in draught is the effect of evaporation, why does it go on in winter as well as in summer?

All these are questions more easily asked than answered; but they must be answered before we can accept the Gibraltar stream as an example of a current produced by indraught with any comfort.

The Mediterranean is not included in the *Challenger's* route, but she will visit one of the most promising and little explored of hydrographical regions–the North Pacific, between Polynesia and the Asiatic and American shores; and doubtless the store of observations upon the currents of this region, which she will accumulate, when compared with what we know of the North Atlantic, will throw a powerful light upon the present obscurity of the Gulf-stream problem.

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[1] *The Depths of the Sea,* pp. 49-50.

[2] The emotional side of the scientific nature has its singularities. Many persons will call to mind a certain philosopher's tenderness over his watch–"the little creature"–which was so singularly lost and found again. But Dr. Wyville Thomson surpasses the owner of the watch in his loving-kindness towards a donkey-engine. "This little engine was the comfort of our lives. Once or twice it was overstrained, and then we pitied the willing little thing, panting like an overtaxed horse."

[3] "Enfin plus bas encore, c'est-à-dire alors loin des côtes, le fond des eaux ne paraît plus être habité, du moins dans nos mers, par aucun de ces animaux" (l. c. tom. i. p. 237). The "ces animaux" leaves the meaning of the authors doubtful.

[4] In the paper in the *Memoirs of the Survey* cited further on, Forbes writes:–

"In an essay 'On the Association of Mollusca on the British Coasts, considered with reference to Pleistocene Geology,' printed in [the *Edinburgh Academic Annual* for] 1840, I described the mollusca, as distributed on our shores and seas in four great zones or regions, usually denominated 'The Littoral Zone,' 'The region of Laminaria,' 'The region of Coral-lines,' and 'The region of Corals.' An extensive series of researches, chiefly conducted by the members of the committee appointed by the British Association to investigate the marine geology of Britain by means of the dredge, have not invalidated this classification, and the researches of Professor Lovén, in the Norwegian and Lapland seas, have borne out their correctness. The first two of the regions above mentioned had been previously noticed by Lamouroux, in his account of the distribution (vertically) of sea-weeds, by Audouin and Milne Edwards in their *Observations on the Natural History of the coast of France,* and by Sars in the preface to his *Beskrivelser og Jagttagelser* ."

[5] *The Depths of the Sea,* p. 30. Results of a similar kind obtained by previous observers, are stated at length in the sixth chapter, pp. 267-280. The dredgings carried out by Count Pourtales, under the authority of Professor Peirce, the Superintendent of the United States Coast Survey, in the years 1867, 1868, and 1869, are particularly noteworthy, and it is probably not too much to say, in the words of Professor Agassiz, "that we owe to the coast survey the first broad and comprehensive basis for an exploration of the sea bottom on a large scale, opening a new era in zoological and geological research."

[6] *Memoirs of the Geological Survey of Great Britain,* Vol i. p. 390.

[7] See above, "On a Piece of Chalk," p. 13.

[8] *The Depths of the Sea,* pp. 51-52.

[9] *The Depths of the Sea,* p. 484.

[10] *Proceedings of the Royal Society,* 1870 and 1872.

Yeast

The Contemporry Review (1871)

Collected Essays VIII

[110] It has been known, from time immemorial, that the sweet liquids which may be obtained by expressing the juices of the fruits and stems of various plants, or by steeping malted barley in hot water, or by mixing honey with water–are liable to undergo a series of very singular changes, if freely exposed to the air and left to themselves, in warm weather. However clear and pellucid the liquid may have been when first prepared, however carefully it may have been freed, by straining and filtration, from even the finest visible impurities, it will not remain clear. After a time it will become cloudy and turbid; little bubbles will be seen rising to the surface, and their abundance will increase until the liquid hisses as if it were simmering on the fire. By degrees, some of the solid particles which produce the turbidity of the liquid [111] collect at its surface into a scum, which is blown up by the emerging air-bubbles into a thick, foamy froth. Another moiety sinks to the bottom, and accumulates as a muddy sediment, or "lees."

When this action has continued, with more or less violence, for a certain time, it gradually moderates. The evolution of bubbles slackens, and finally comes to an end; scum and lees alike settle at the bottom, and the fluid is once more clear and transparent. But it has acquired properties of which no trace existed in the original liquid. Instead of being a mere sweet fluid, mainly composed of sugar and water, the sugar has more or less completely disappeared; and it has acquired that peculiar smell and taste which we call "spirituous." Instead of being devoid of any obvious effect upon the animal economy, it has become possessed of a very wonderful influence on the nervous system; so that in small doses it exhilarates, while in larger it stupefies, and may even destroy life.

Moreover, if the original fluid is put into a still, and heated moderately, the first and last product of its distillation is simple water; while, when the altered fluid is subjected to the same process, the matter which is first condensed in the receiver is found to be a clear, volatile substance, which is lighter than water, has a pungent taste and smell, possesses the intoxicating powers of the fluid in an eminent degree, and takes fire the moment it [112] is brought in contact with a flame. The Alchemists called this volatile liquid, which they obtained from wine, "spirits of wine," just as they called hydrochloric acid "spirits of salt," and as we, to this day, call refined turpentine "spirits of turpentine." As the "spiritus," or breath, of a man was thought to be the most refined and subtle part of him, the intelligent essence of man was also conceived as a sort of breath, or spirit; and, by analogy, the most refined essence of anything was called its "spirit." And thus it has come about that we use the same word for the soul of man and for a glass of gin.

At the present day, however, we even more commonly use another name for this peculiar liquid–namely, "alcohol," and its origin is not less singular. The Dutch physician, Van Helmont, lived in the latter part of the sixteenth and the beginning of the seventeenth century–in the transition period between alchemy

and chemistry–and was rather more alchemist than chemist. Appended to his "Opera Omnia," published in 1707, there is a very needful "Clavis ad obscuriorum sensum referendum," in which the following passage occurs:–

Alcohol–Chymicis est liquor aut pulvis summè subtilisatus, vocabulo Orientalibus quoque, cum primis Habessinis, familiari, quibus *cohol* speciatim pulverem impalpabilem es antimonio pro oculis tingendis denotat . . . Hodie autem, ob analogiam, quivis pulvis tenerior ut pulvis oculorum cancri [113] summè subtilisatus *alcohol* audit, haud aliter ac spiritus rectificatissimi *alcolisati* dicuntur."

Similarly, Robert Boyle speaks of a fine powder as "alcohol"; and, so late as the middle of the last century, the English lexicographer, Nathan Bailey, defines "alcohol" as "the pure substance of anything separated from the more gross, a very fine and impalpable powder, or a very pure, well-rectified spirit." But, by the time of the publication of Lavoisier's "Traité Eléementaire de Chimie," in 1789, the term "alcohol," "alkohol," or "alkool" (for it is spelt in all three ways), which Van Helmont had applied primarily to a fine powder, and only secondarily to spirits of wine, had lost its primary meaning altogether; and, from the end of the last century until now, it has, I believe, been used exclusively as the denotation of spirits of wine, and bodies chemically allied to that substance.

The process which gives rise to alcohol in a saccharine fluid is known to us as "fermentation"; a term based upon the apparent boiling up or "effervescence" of the fermenting liquid, and of Latin origin.

Our Teutonic cousins call the same process "gähren," "gäsen," "göschen," and "gischen"; but, oddly enough, we do not seem to have retained their verb or their substantive denoting the action itself, though we do use names identical with, or plainly derived from, theirs for [114] the scum and lees. These are called, in Low German, "gäscht" and "gischt"; in Anglo-Saxon "gest," "gist," and "yst," whence our "yeast." Again, in Low German and in Anglo-Saxon there is another name for yeast, having the form "barm," or "beorm"; and, in the Midland Counties, "barm" is the name by which yeast is still best known. In High German, there is a third name for yeast, "hefe," which is not represented in English, so far as I know.

All these words are said by philologers to be derived from roots expressive of the intestine motion of a fermenting substance. Thus "hefe" is derived from "heben," to raise; "barm" from "beren" or "bären," to bear up; "yeast," "yst," and "gist," have all to do with seething and foam, with "yeasty" waves, and "gusty" breezes.

The same reference to the swelling up of the fermenting substance is seen in the Gallo-Latin terms "levure" and "leaven."

It is highly creditable to the ingenuity of our ancestors that the peculiar property of fermented liquids, in virtue of which they "make glad the heart of man," seems to have been known in the remotest periods of which we have any record. All savages take to alcoholic fluids as if they were to the manner born. Our Vedic forefathers intoxicated themselves with the juice of the "soma"; Noah, by a not unnatural reaction against a superfluity of water, appears to have [115] taken the earliest practicable opportunity of

qualifying that which he was obliged to drink; and the ghosts of the ancient Egyptians were solaced by pictures of banquets in which the wine-cup passes round, graven on the walls of their tombs. A knowledge of the process of fermentation, therefore, was in all probability possessed by the prehistoric populations of the globe; and it must have become a matter of great interest even to primæval wine-bibbers to study the methods by which fermented liquids could be surely manufactured. No doubt it was soon discovered that the most certain, as well as the most expeditious, way of making a sweet juice ferment was to add to it a little of the scum, or lees, of another fermenting juice. And it can hardly be questioned that this singular excitation of fermentation in one fluid, by a sort of infection, or inoculation, of a little ferment taken from some other fluid, together with the strange swelling, foaming, and hissing of the fermented substance, must have always attracted attention from the more thoughtful. Nevertheless, the commencement of the scientific analysis of the phenomena dates from a period not earlier than the first half of the seventeenth century.

At this time, Van Helmont made a first step, by pointing out that the peculiar hissing and bubbling of a fermented liquid is due, not to the evolution of common air (which he, as the inventor [116] of the term "gas," calls "gas ventosum"), but to that of a peculiar kind of air such as is occasionally met with in caves, mines, and wells, and which he calls "gas sylvestre."

But a century elapsed before the nature of this "gas sylvestre," or, as it was afterwards called, "fixed air," was clearly determined, and it was found to be identical with that deadly "choke-damp" by which the lives of those who descend into old wells, or mines, or brewers' vats, are sometimes suddenly ended; and with the poisonous aëriform fluid which is produced by the combustion of charcoal, and now goes by the name of carbonic acid gas.

During the same time it gradually became evident that the presence of sugar was essential to the production of alcohol and the evolution of carbonic acid gas, which are the two great and conspicuous products of fermentation. And finally, in 1787, the Italian chemist, Fabroni, made the capital discovery that the yeast ferment, the presence of which is necessary to fermentation, is what he termed a "vegeto-animal" substance; that is, a body which gives off ammoniacal salts when it is burned, and is, in other ways, similar to the gluten of plants and the albumen and casein of animals.

These discoveries prepared the way for the illustrious Frenchman, Lavoisier, who first approached the problem of fermentation with a [117] complete conception of the nature of the work to be done. The words in which he expresses this conception, in the treatise on elementary chemistry to which reference has already been made, mark the year 1789 as the commencement of a revolution of not less moment in the world of science than that which simultaneously burst over the political world, and soon engulfed Lavoisier himself in one of its mad eddies.

"We may lay it down as an incontestable axiom that, in all the operations of art and nature, nothing is created; an equal quantity of matter exists both before and after the experiment: the quality and quantity of the elements remain precisely the same, and nothing hikes place beyond changes and modifications in the combinations of these elements. Upon this principle the whole art of performing chemical experiments depends; we must always suppose an exact equality between the elements of the body examined and those of the products of its analysis.

"Hence, since from must of grapes we procure alcohol and carbonic acid, I have an undoubted right to suppose that must consists of carbonic acid and alcohol. From these premisses we have two modes of ascertaining what passes during vinous fermentation: either by determining the nature of, and the elements which compose, the fermentable substances; or by accurately examining the products resulting from fermentation; and it is evident that the knowledge of either of these must lead to accurate conclusions concerning the nature and composition of the other. From these considerations it became necessary accurately to determine the constituent elements of the fermentable substances; and for this purpose I did not make use of the compound juices of fruits, the rigorous analysis of which is perhaps impossible, but made choice of sugar, which is easily analysed, and the nature of which I have already explained. This substance is a true vegetable oxyd, with two bases, composed of [118] hydrogen and carbon, brought to the state of an oxyd by means of a certain proportion of oxygen; and these three elements are combined in such a way that a very slight force is sufficient to destroy the equilibrium of their connection."

After giving the details of his analysis of sugar and of the products of fermentation, Lavoisier continues:–

The effect of the vinous fermentation upon sugar is thus reduced to the mere separation of its elements into two portions; one part is oxygenated at the expense of the other, so as to form carbonic acid; while the other part, being disoxygenated in favour of the latter, is converted into the combustible substance called alkohol; therefore, if it were possible to re-unite alkohol and carbonic acid together, we ought to form sugar."[1]

Thus Lavoisier thought he had demonstrated that the carbonic acid and the alcohol which are produced by the process of fermentation, are equal in weight to the sugar which disappears; but the application of the more refined methods of modern chemistry to the investigation of the products of fermentation by Pasteur, in 1860 proved that this is not exactly true, and that there is a deficit of from 5 to 7 per cent. of the sugar which is not covered by the alcohol and carbonic acid evolved. The greater part of this deficit is accounted for by the discovery of two substances, glycerine and succinic acid, of the existence of which Lavoisier was unaware, in the [119] fermented liquid. But about 1-1/2 per cent. still remains to be made good. According to Pasteur, it has been appropriated by the yeast, but the fact that such appropriation takes place cannot be said to be actually proved.

However this may be, there can be no doubt that the constituent elements of fully 98 per cent. of the sugar which has vanished during fermentation have simply undergone rearrangement; like the soldiers of a brigade, who at the word of command divide themselves into the independent regiments to which they belong. The brigade is sugar, the regiments are carbonic acid, succinic acid, alcohol, and glycerine.

From the time of Fabroni, onwards, it has been admitted that the agent by which this surprising rearrangement of the particles of the sugar is effected is the yeast. But the first thoroughly conclusive evidence of the necessity of yeast for the fermentation of sugar was furnished by Appert, whose method of preserving perishable articles of food excited so much attention in France at the beginning of this century. Gay-Lussac, in his "Memoire sur la Fermentation,"[2] alludes to Appert's method of preserving beer-wort unfermented for an indefinite time, by simply boiling the wort and closing the vessel in which the boiling fluid is contained, in such a way as thoroughly to exclude air; and he [120] shows that, if a

little yeast be introduced into such wort, after it has cooled, the wort at once begins to ferment, even though every precaution be taken to exclude air. And this statement has since received full confirmation from Pasteur.

On the other hand, Schwann, Schroeder and Dusch, and Pasteur, have amply proved that air may be allowed to have free access to beer-wort, without exciting fermentation, if only efficient precautions are taken to prevent the entry of particles of yeast along with the air.

Thus, the truth that the fermentation of a simple solution of sugar in water depends upon the presence of yeast, rests upon an unassailable foundation; and the inquiry into the exact nature of the substance which possesses such a wonderful chemical influence becomes profoundly interesting.

The first step towards the solution of this problem was made two centuries ago by the patient and painstaking Dutch naturalist, Leeuwenhoek, who in the year 1680 wrote thus:–

Sapissime examinavi fermentum cerevisiæ, semperque hoc ex globulis per materiam pellucidam fluitantibus, quam cerevisiam esse censui, constare observavi: vidi etiam evidentissime, unumquemque hujus fermenti globulum denuo ex sex distinctis globulis constare, accurate eidem quantitate et formæ, cui globulis sanguinis nostri, respondentibus.

"Verum talis mihi de horum origine et formatione conceptus formabam; globulis nempe ex quibus farina Tritici, Hordei, Avenæ, Fagotritici, se constat aquæ calore dissolvi et aquæ com[121]misceri; hac, vero aqua, quam cerevisiam vocare licet, refrigescente, multos ex minimis particulis in cerevisia coadunari, et hoc pacto efficere particulam sive globulum, quæ sexta pars est globuli fæcis, et iterum sex ex hisce globulis conjungi."[3]

Thus Leeuwenhoek discovered that yeast consists of globules floating in a fluid; but he thought that they were merely the starchy particles of the grain from which the wort was made, rearranged. He discovered the fact that yeast had a definite structure, but not the meaning of the fact. A century and a half elapsed, and the investigation of yeast was recommenced almost simultaneously by Cagniard de la Tour in France, and by Schwann and Kützing in Germany. The French observer was the first to publish his results; and the subject received at his hands and at those of his colleague, the botanist Turpin, full and satisfactory investigation.

The main conclusions at which they arrived are these. The globular, or oval, corpuscles which float so thickly in the yeast as to make it muddy, though the largest are not more than one two-thousandth of an inch in diameter, and the smallest may measure less than one seven-thousandth of an inch, are living organisms. They multiply with great rapidity by giving off minute buds, which soon attain the size of their parent, and then either become detached or remain united, forming the compound globules of which [122] Leeuwenhoek speaks, though the constancy of their arrangement in sixes existed only in the worthy Dutchman's imagination.

It was very soon made out that these yeast organisms, to which Turpin gave the name of *Torula*

cerevisiæ, were more nearly allied to the lower Fungi than to anything else. Indeed Turpin, and subsequently Berkeley and Hoffmann, believed that they had traced the development of the *Tortu1a* into the well-known and very common mould–the *Penicillium glaucum* . Other observers have not succeeded in verifying these statements; and my own observations lead me to believe, that while the connection between *Tortula* and the moulds is a very close one, it is of a different nature from that which has been supposed. I have never been able to trace the development of *Tortula* into a true mould; but it is quite easy to prove that species of true mould, such as *Penicillium,* when sown in an appropriate nidus, such as a solution of tartrate of ammonia and yeast-ash, in water, with or without sugar, give rise to *Torulæ,* similar in all respects to *T. cerevisiæ,* except that they are, on the average, smaller. Moreover, Bail has observed the development of a *Tortula* larger than *T. cerevisiæ,* from a *Mucor,* a mould allied to *Penicillium* .

It follows, therefore, that the *Torulæ,* or organisms of yeast, are veritable plants; and conclusive experiments have proved that the power [123] which causes the rearrangement of the molecules of the sugar is intimately connected with the life and growth of the plant. In fact, whatever arrests the vital activity of the plant also prevents it from exciting fermentation.

Such being the facts with regard to the nature of yeast, and the changes which it effects in sugar, how are they to be accounted for? Before modern chemistry had come into existence, Stahl, stumbling, with the stride of genius, upon the conception which lies at the bottom of all modern views of the process, put forward the notion that the ferment, being in a state of internal motion, communicated that motion to the sugar, and thus caused its resolution into new substances. And Lavoisier, as we have seen, adopts substantially the same view. But Fabroni, full of the then novel conception of acids and bases and double decompositions, propounded the hypothesis that sugar is an oxide with two bases, and the ferment a carbonate with two bases; that the carbon of the ferment unites with the oxygen of the sugar, and gives rise to carbonic acid; while the sugar, uniting with the nitrogen of the ferment, produces a new substance analogous to opium. This is decomposed by distillation, and gives rise to alcohol. Next, in 1803, Thénard propounded a hypothesis which partakes somewhat of the nature of both Stahl's and Fabroni's views. "I do not believe with Lavoisier," he says, "that all the [124] carbonic acid formed proceeds from the sugar. How, in that case, could we conceive the action of the ferment on it? I think that the first portions of the acid are due to a combination of the carbon of the ferment with the oxygen of the sugar, and that it is by carrying off a portion of oxygen from the last that the ferment causes the fermentation to commence–the equilibrium between the principles of the sugar being disturbed, they combine afresh to form carbonic acid and alcohol."

The three views here before us may be familiarly exemplified by supposing the sugar to be a card-house. According to Stahl, the ferment is somebody who knocks the table, and shakes the card-house down; according to Fabroni, the ferment takes out some cards, but puts others in their places; according to Thénard, the ferment simply takes a card out of the bottom story, the result of which is that all the others fall.

As chemistry advanced, facts came to light which put a new face upon Stahl's hypothesis, and gave it a safer foundation than it previously possessed. The general nature of these phenomena may be thus

stated:–A body, A, without giving to, or taking from, another body B, any material particles, causes B to decompose into other substances, C, D, E, the sum of the weights of which is equal to the weight of B. which decomposes.

Thus, bitter almonds contain two substances, [125] amygdalin and synaptase, which can be extracted, in a separate state, from the bitter almonds. The amygdalin thus obtained, if dissolved in water, undergoes no change; but if a little synaptase be added to the solution, the amygdalin splits up into bitter almond oil, prussic acid, and a kind of sugar.

A short time after Cagniard de la Tour discovered the yeast plant, Liebig, struck with the similarity between this and other such processes and the fermentation of sugar, put forward the hypothesis that yeast contains a substance which acts upon sugar, as synaptase acts upon amygdalin. And as the synaptase is certainly neither organized nor alive, but a mere chemical substance, Liebig treated Cagniard de la Tour's discovery with no small contempt, and, from that time to the present, has steadily repudiated the notion that the decomposition of the sugar is, in any sense, the result of the vital activity of the *Tortula.* But, though the notion that the *Tortula* is a creature which eats sugar and excretes carbonic acid and alcohol, which is not unjustly ridiculed in the most surprising paper that ever made its appearance in a grave scientific journal,[4] may be un[126]tenable, the fact that the *Torulæ* are alive, and that yeast does not excite fermentation unless it contains living *Torulæ,* stands fast. Moreover, of late years, the essential participation of living organisms in fermentation other than the alcoholic, has been clearly made out by Pasteur and other chemists.

However, it may be asked, is there any necessary opposition between the so-called "vital" and the strictly physico-chemical views of fermentation? It is quite possible that the living *Tortula* may excite fermentation in sugar, because it constantly produces, as an essential part of its vital manifestations, some substance which acts upon the sugar, just as the synaptase acts upon the amygdalin. Or it may be, that, without the formation of any such special substance, the physical condition of the living tissue of the yeast plant is sufficient to effect that small disturbance of the equilibrium of the particles of the sugar, which Lavoisier thought sufficient to effect its decomposition.

Platinum in a very fine state of division–known as platinum black, or *noir de platine*–has [127] the very singular property of causing alcohol to change into acetic acid with great rapidity. The vinegar plant, which is closely allied to the yeast plant, has a similar effect upon dilute alcohol, causing it to absorb the oxygen of the air, and become converted into vinegar; and Liebig's eminent opponent, Pasteur, who has done so much for the theory and the practice of vinegar-making, himself suggests that in this case–

La cause du phénomène physique qui accompagne la vie de la plante réside dans un état physique propre, analogue à celui du noir de platine. Mais il est essentiel de remarquer que cet état physique de la plante est étroitement lié avec la vie de cette plante."[5]

Now, if the vinegar plant gives rise to the oxidation of alcohol, on account of its merely physical constitution, it is at any rate possible that the physical constitution of the yeast plant may exert a

decomposing influence on sugar.

But, without presuming to discuss a question which leads us into the very arcana of chemistry, the present state of speculation upon the *modus operandi* of the yeast plant in producing fermentation is represented, on the one hand, by the Stahlian doctrine, supported by Liebig, according to which the atoms of the sugar are shaken into new combinations, either directly by the *Torulæ,* or indirectly, by some substance formed by them; [128] and, on the other hand, by the Thénardian doctrine, supported by Pasteur, according to which the yeast plant assimilates part of the sugar, and, in so doing, disturbs the rest, and determines its resolution into the products of fermentation. Perhaps the two views are not so much opposed as they seem at first sight to be.

But the interest which attaches to the influence of the yeast plants upon the medium in which they live and grow does not arise solely from its bearing upon the theory of fermentation. So long ago as 1838, Turpin compared the *Torulæ* to the ultimate elements of the tissues of animals and plants–"Les organes élémentaires de leurs tissus, comparables aux petits végétaux des levures ordinaires, sont aussi les décompositeurs des substances qui les environnent."

Almost at the same time, and, probably, equally guided by his study of yeast, Schwann was engaged in those remarkable investigations into the form and development of the ultimate structural elements of the tissues of animals, which led him to recognise their fundamental identity with the ultimate structural elements of vegetable organisms.

The yeast plant is a mere sac, or "cell," containing a semi-fluid matter, and Schwann's microscopic analysis resolved all living organisms, in the long run, into an aggregation of such sacs or cells, variously modified; and tended to show, that all, [129] whatever their ultimate complication, begin their existence in the condition of such simple cells.

In his famous "Mikroskopische Untersuchungen" Schwann speaks of *Tortula* as a "cell"; and, in a remarkable note to the passage in which he refers to the yeast plant, Schwann says:–

I have been unable to avoid mentioning fermentation, because it is the most fully and exactly known operation of cells, and represents, in the simplest fashion, the process which is repeated by every cell of the living body."

In other words, Schwann conceives that every cell of the living body exerts an influence on the matter which surrounds and permeates it, analogous to that which a *Tortula* exerts on the saccharine solution by which it is bathed. A wonderfully suggestive thought, opening up views of the nature of the chemical processes of the living body, which have hardly yet received all the development of which they are capable.

Kant defined the special peculiarity of the living body to be that the parts exist for the sake of the whole and the whole for the sake of the parts. But when Turpin and Schwann resolved the living body into an aggregation of quasi-independent cells, each, like a *Tortula,* leading its own life and having its own laws

of growth and development, the aggregation being dominated and kept working towards a definite end only by a certain harmony among these units, or by the superaddition [130] of a controlling apparatus, such as a nervous system, this conception ceased to be tenable. The cell lives for its own sake, as well as for the sake of the whole organism; and the cells which float in the blood, live at its expense, and profoundly modify it, are almost as much independent organisms as the *Torulæ* which float in beer-wort.

Schwann burdened his enunciation of the "cell theory" with two false suppositions; the one, that the structures he called "nucleus"[6] and "cell-wall" are essential to a cell; the other, that cells are usually formed independently of other cells; but, in 1839, it was a vast and clear gain to arrive at the conception, that the vital functions of all the higher animals and plants are the resultant of the forces inherent in the innumerable minute cells of which they are composed, and that each of them is, itself, an equivalent of one of the lowest and simplest of independent living beings–the *Tortula* .

From purely morphological investigations, Turpin and Schwann, as we have seen, arrived at the notion of the fundamental unity of structure of living beings. And, before long, the researches of chemists gradually led up to the conception of the fundamental unity of their composition.

So far back as 1803, Thénard pointed out, in [131] most distinct terms, the important fact that yeast contains a nitrogenous "animal" substance; and that such a substance is contained in all ferments. Before him, Fabroni and Fourcroy speak of the "vegeto-animal" matter of yeast. In 1844 Mulder endeavoured to demonstrate that a peculiar substance, which he called "protein," was essentially characteristic of living matter.

In 1846, Payen writes:–

Enfin, une loi sans exception me semble apparaître done les faits nombreux que j'ai observés et conduire à envisager sous un nouveau jour la vie végétale; si je ne m'abuse, tout ce que dans les tissus végétaux la vue directe où amplifiée nous permet de discerner sous la forme de cellules et de vaisseaux, ne représente autre chose que les enveloppes protectrices, les réservoirs et les conduits, à l'aide desquels les corps animés qui les secrètent et les façonnent, se logent, puisent et charrient leurs aliments, déposent et isolent les matières excrétées."

And again:–

Afin de compléter aujourd'hui l'énoncé du fait général, je rappellerai que les corps, doué des fonctions accomplies dans les tissus des plantes, sont formés des éléments qui constituent, en proportion peu variable, les organismes animaux; qu'ainsi l'on est conduit a reconnaître une immense unité de composition élémentaire dans tous les corps vivants de la nature."[7]

In the year (1846) in which these remarkable passages were published, the eminent German botanist, Von Mohl, invented the word "protoplasm," as a name for one portion of those nitrogenous contents of the cells of living plants, the [132] close chemical resemblance of which to the essential constituents of living animals is so strongly indicated by Payen. And through the twenty-five years that have passed,

since the matter of life was first called protoplasm, a host of investigators, among whom Cohn, Max Schulze, and Kühne must be named as leaders, have accumulated evidence, morphological, physiological, and chemical, in favour of that "immense unité de composition élémentaire dans tous les corps vivants de la nature," into which Payen had, so early, a clear insight.

As far back as 1850, Cohn wrote, apparently without any knowledge of what Payen had said before him:–

The protoplasm of the botanist, and the contractile substance and sarcode of the zoologist, must be, if not identical, yet in a high degree analogous substances. Hence, from this point of view, the difference between animals and plants consists in this; that, in the latter, the contractile substance, as a primordial utricle, is enclosed within an inert cellulose membrane, which permits it only to exhibit an internal motion, expressed by the phenomena of rotation and circulation, while, in the former, it is not so enclosed. The protoplasm in the form of the primordial utricle is, as it were, the animal element in the plant, but which is imprisoned, and only becomes free in the animal; or to strip off the metaphor which obscures simple thought, the energy of organic vitality which is manifested in movement is especially exhibited by a nitrogenous contractile substance, which in plants is limited and fettered by an inert membrane, in animals not so."[8]

[133] In 1868, thinking that an untechnical statement of the views current among the leaders of biological science might be interesting to the general public, I gave a lecture embodying them in Edinburgh. Those who have not made the mistake of attempting to approach biology, either by the high *a priori* road of mere philosophical speculation, or by the mere low a *a posteriori* lane offered by the tube of a microscope, but have taken the trouble to become acquainted with well-ascertained facts and with their history, will not need to be told that in what I had to say "as regards protoplasm" in my lecture "On the Physical Basis of Life" (Vol. I. of these Essays, p. 130), there was nothing new; and, as I hope, nothing that the present state of knowledge does not justify us in believing to be true. Under these circumstances, my surprise may be imagined, when I found, that the mere statement of facts and of views, long familiar to me as part of the common scientific property of Continental workers, raised a sort of storm in this country, not only by exciting the wrath of unscientific persons whose pet prejudices they seemed to touch, but by giving rise to quite superfluous explosions on the part of some who should have been better informed.

Dr. Stirling, for example, made my essay the subject of a special critical lecture[9] which I have [134] read with much interest, though, I confess, the meaning of much of it remains as dark to me as does the "Secret of Hegel" after Dr. Stirling's elaborate revelation of it. Dr. Stirling's method of dealing with the subject is peculiar. "Protoplasm" is a question of history, so far as it is a name; of fact, so far as it is a thing. Dr. Stirling has not taken the trouble to refer to the original authorities for his history, which is consequently a travesty; and still less has he concerned himself with looking at the facts, but contents himself with taking them also at second-hand. A most amusing example of this fashion of dealing with scientific statements is furnished by Dr. Stirling's remarks upon my account of the protoplasm of the nettle hair. That account was drawn up from careful and often-repeated observation of the facts. Dr. Stirling thinks he is offering a valid criticism, when he says that my valued friend Professor Stricker gives a somewhat different statement about protoplasm. But why in the world did not this distinguished

Hegelian look at a nettle hair for himself, before venturing to speak about the matter at all? Why trouble himself about what either Stricker or I say, when any tyro can see the facts for himself, if he is provided with those not rare articles, a nettle and a microscope? But I suppose this would have been "*Aufklärung*"–a recurrence to the base common-sense philosophy of the eighteenth century, which liked to see before it [135] believed, and to understand before it criticised. Dr. Stirling winds up his paper with the following paragraph:–

In short, the whole position of Mr. Huxley, (l) that all organisms consist alike of the same life-matter, (2) which life-matter is, for its part, due only to chemistry, must be pronounced untenable–nor less untenable (3) the materialism he would found on it."

The paragraph contains three distinct assertions concerning my views, and just the same number of utter misrepresentations of them. That which I have numbered (1) turns on the ambiguity of the word "same," for a discussion of which I would refer Dr. Stirling to a great hero of "*Aufklärung*," Archbishop Whately; statement number (2) is, in my judgment, absurd, and certainly I have never said anything resembling it; while, as to number (3), one great object of my essay was to show that what is called "materialism" has no sound philosophical basis!

As we have seen, the study of yeast has led investigators face to face with problems of immense interest in pure chemistry, and in animal and vegetable morphology. Its physiology is not less rich in subjects for inquiry. Take, for example, the singular fact that yeast will increase indefinitely when grown in the dark, in water containing only tartrate of ammonia, a small percentage of mineral salts, and sugar. Out of these materials the *Torulæ* will manufacture nitrogenous proto[136]plasm, cellulose, and fatty matters, in any quantity, although they are wholly deprived of those rays of the sun, the influence of which is essential to the growth of ordinary plants. There has been a great deal of speculation lately, as to how the living organisms buried beneath two or three thousand fathoms of water, and therefore in all probability almost deprived of light, live. If any of them possess the same powers as yeast (and the same capacity for living without light is exhibited by some other fungi) there would seem to be no difficulty about the matter.

Of the pathological bearings of the study of yeast, and other such organisms, I have spoken elsewhere. It is certain that, in some animals devastating epidemics are caused by fungi of low order–similar to those of which *Tortula* is a sort of offshoot. It is certain that such diseases are propagated by contagion and infection, in just the same way as ordinary contagious and infectious diseases are propagated. Of course, it does not follow from this, that all contagious and infectious diseases are caused by organisms of as definite and independent a character as the *Tortula;* but I think, it does follow that it is prudent and wise to satisfy one's self in each particular case, that the "germ theory" cannot and will not explain the facts, before having recourse to hypotheses which have no equal support from analogy.

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[1] *Elements of Chemistry.* By M. Lavoisier. Translated by Robert Kerr. Second Edition, 1793 (pp. 186-196).

[2] *Annales de Chimie*, 1810.

[3] Leeuwenhoek, *Arcana Naturæ Detecta*. . Ed. Nov., 1721.

[4] "Das enträthselte Geheimniss der geistigen Gährung (Vorläufige briefliche Mittheilung)" is the title of an anonymous contribution to Wöhler and Liebig's *Annalen der Pharmacie* for 1839, in which a somewhat Rabelaisian imaginary description of the organisation of the "yeast animals" and of the manner in which their functions are performed, is given with a circumstantiality worthy of the author of *Gulliver's Travels* . As a specimen of the writer's humour, his account of what happens when fermentation comes to an end may suffice. "Sobald nämlich die Thiere keinen Zucker mehr vorfinden, so fressen sie sich gegenseitig selbst auf, was durch eine eigene Manipulation geschieht; alles wird verdaut bis auf die Eier, welche unverändert durch den Darmkanal hineingehen; man hat zuletzt wieder gährungsfäähige Hefe, nämliche den Saamen der Thiere, der übrig bleibt."

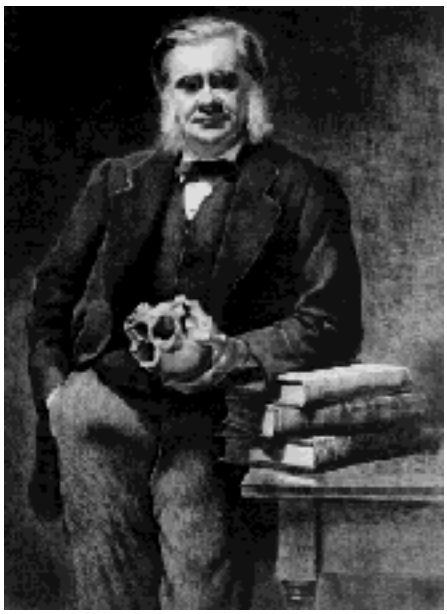
[5] *Etudes sur les Mycodermes*, Comptes-Rendus, liv., 1862.

[6] [Later investigations have thrown an entirely new light upon the structure and the functional importance of the nucleus; and have proved that Schwann did not over-estimate its importance. 1894.]

[7] "Mém. sur les Développements des Végétaux," &c.–*Mém. Présentées.* ix 1846.

[8] Cohn, "Ueber Protococcus pluvialis," in the *Nova Acta* for 1850.

[9] Subsequently published under the title of "As regards Protoplasm."



On the Formation of Coal

The Contemporary Review (1870)

Collected Essays VIII

[137] The lumps of coal in a coal-scuttle very often have a roughly cubical form. If one of them be picked out and examined with a little care, it will be found that its six sides are not exactly alike. Two opposite sides are comparatively smooth and shining, while the other four are much rougher, and are marked by lines which run parallel with the smooth sides. The coal readily splits along these lines, and the split surfaces thus formed are parallel with the smooth faces. In other words, there is a sort of rough and incomplete stratification in the lump of coal, as if it were a book, the leaves of which had stuck together very closely.

Sometimes the faces along which the coal splits are not smooth, but exhibit a thin layer of dull, charred-looking substance, which is known as "mineral charcoal."

[138] Occasionally one of the faces of a lump of coal will present impressions, which are obviously those of the stem, or leaves, of a plant; but though hard mineral masses of pyrites, and even fine mud, may occur here and there, neither sand nor pebbles are met with.

When the coal burns, the chief ultimate products of its combustion are carbonic acid, water, and ammoniacal products, which escape up the chimney; and a greater or less amount of residual earthy salts, which take the form of ash. These products are, to a great extent, such as would result from the burning of so much wood.

These properties of coal may be made out without any very refined appliances, but the microscope reveals something more. Black and opaque as ordinary coal is, slices of it become transparent if they are cemented in Canada balsam, and rubbed down very thin, in the ordinary way of making thin sections of nontransparent bodies. But as the thin slices, made in this way, are very apt to crack and break into fragments, it is better to employ marine glue as the cementing material. By the use of this substance, slices of considerable size and of extreme thinness and transparency may be obtained.[1]

[139] Now let us suppose two such slices to be prepared from our lump of coal–one parallel with the bedding, the other perpendicular to it; and let us call the one the horizontal, and the other the vertical, section. The horizontal section will present more or less rounded yellow patches and streaks, scattered irregularly through the dark brown, or blackish, ground substance; while the vertical section will exhibit mere elongated bars and granules of the same yellow materials, disposed in lines which correspond, roughly, with the general direction of the bedding of the coal.

This is the microscopic structure of an ordinary piece of coal. But if a great series of coals, from different localities and seams, or even from different parts of the same seam, be examined, this structure will be found to vary in two directions. In the anthracitic, or stone-coals, which burn like coke, the yellow matter diminishes, and the ground substance becomes more predominant, blacker, and more opaque, until it becomes impossible to grind a section thin enough to be translucent; while, on the other hand, in such as the "Better-Bed" coal of the neighbourhood of Bradford, which burns with much flame, the coal is of a far lighter colour, and transparent sections are very easily obtained. In the browner parts of this coal, sharp eyes will readily detect multitudes of curious little coin-shaped bodies, of a yellowish brown colour, embedded in the dark brown ground substance. On the average, these little brown bodies may have a diameter of about one-twentieth of an inch. They lie with their flat surfaces nearly parallel with the two smooth faces of the block in which they are contained; and, on one side of each, there may be discerned a figure, consisting of three straight linear marks, which radiate from the centre of the disk, but do not quite reach its circumference. In the horizontal section these disks are often converted into more or less complete rings; while in the vertical sections they appear like thick hoops, the sides of which have been pressed together. The disks are, therefore, flattened bags; and favourable sections show that the three-rayed marking is the expression of three clefts, which penetrate one wall of the bag.

The sides of the bags are sometimes closely approximated; but, when the bags are less flattened, their cavities are, usually, filled with numerous, irregularly rounded, hollow bodies, having the same kind of wall as the large ones, but not more than one seven-hundredth of an inch in diameter.

In favourable specimens, again, almost the whole ground substance appears to be made up of similar bodies–more or less carbonized or blackened–and, in these, there can be no doubt that, with the exception of patches of mineral charcoal, here and there, the whole mass of the [141] coal is made up of an accumulation of the larger and of the smaller sacs.

But, in one and the same slice, every transition can be observed from this structure to that which has been described as characteristic of ordinary coal. The latter appears to rise out of the former, by the breaking-up and increasing carbonization of the larger and the smaller sacs. And, in the anthracitic coals, this process appears to have gone to such a length, as to destroy the original structure altogether, and to replace it by a completely carbonized substance.

Thus coal may be said, speaking broadly, to be composed of two constituents: firstly, mineral charcoal; and, secondly, coal proper. The nature of the mineral charcoal has long since been determined. Its structure shows it to consist of the remains of the stems and leaves of plants, reduced a little more than their carbon. Again, some of the coal is made up of the crushed and flattened bark, or outer coat, of the stems of plants, the inner wood of which has completely decayed away. But what I may term the "saccular matter" of the coal, which, either in its primary or in its degraded form, constitutes by far the greater part of all the bituminous coals I have examined, is certainly not mineral charcoal; nor is its structure that of any stem or leaf. Hence its real nature is, at first, by no means apparent, and has been the subject of much discussion.

[142] The first person who threw any light upon the problem, as far as I have been able to discover, was the well-known geologist, Professor Morris. It is now thirty-four years since he carefully described and figured the coin-shaped bodies, or larger sacs, as I have called them, in a note appended to the famous paper "On the Coalbrookdale Coal-Field," published at that time, by the present President of the Geological Society, Mr. Prestwich. With much sagacity, Professor Morris divined the real nature of these bodies, and boldly affirmed them to be the spore-cases of a plant allied to the living club-mosses.

But discovery sometimes makes a long halt; and it is only a few years since Mr. Carruthers determined the plant (or rather one of the plants) which produces these spore-cases, by finding the discoidal sacs still adherent to the leaves of the fossilized cone which produced them. He gave the name of *Flemingites gracilis* to the plant of which the cones form a part. The branches and stem of this plant are not yet certainly known, but there is no sort of doubt that it was closely allied to the *Lepidodendron*, the remains of which abound in the coal formation. The *Lepidodendra* were shrubs and trees which put one more in mind of an *Araucaria* than of any other familiar plant; and the ends of the fruiting branches were terminated by cones, or catkins, somewhat like the bodies so named in a fir, or a [143] willow. These conical fruits, however, did not produce seeds; but the leaves of which they were composed bore upon their surfaces sacs full of spores or sporangia, such as those one sees on the under surface of a bracken leaf. Now, it is these sporangia of the Lepidodendroid plant *Flemingites* which were identified by Mr. Carruthers with the free sporangia described by Professor Morris, which are the same as the large sacs of which I have spoken. And, more than this, there is no doubt that the small sacs are the spores, which were originally contained in the sporangia.

The living club-mosses are, for the most part, insignificant and creeping herbs, which, superficially, very closely resemble true mosses, and none of them reach more than two or three feet in height. But, in their essential structure, they very closely resemble the earliest Lepidodendroid trees of the coal: their stems and leaves are similar; so are their cones; and no less like are the sporangia and spores; while even in their size, the spores of the *Lepidodendron* and those of the existing *Lycopodium*, or club-moss, very closely approach one another.

Thus, the singular conclusion is forced upon us, that the greater and the smaller sacs of the "Better-Bed" and other coals, in which the primitive structure is well preserved, are simply the sporangia and spores of certain plants, many [144] of which were closely allied to the existing club-mosses. And if, as I believe, it can be demonstrated that ordinary coal is nothing but "saccular" coal which has undergone a certain amount of that alteration which, if continued, would convert it into anthracite; then, the conclusion is obvious, that the great mass of the coal we burn is the result of the accumulation of the spores and spore-cases of plants, other parts of which have furnished the carbonized stems and the mineral charcoal, or have left their impressions on the surfaces of the layer.

Of the multitudinous speculations which, at various times, have been entertained respecting the origin and mode of formation of coal, several appear to be negatived, and put out of court, by the structural facts the significance of which I have endeavoured to explain. These facts, for example, do not permit us to suppose that coal is an accumulation of peaty matter, as some have held.

Again, the late Professor Quekett was one of the first observers who gave a correct description of what I have termed the "saccular" structure of coal; and, rightly perceiving that this structure was something quite different from that of any known plant, he imagined that it proceeded from some extinct vegetable organism which was peculiarly abundant amongst the coal-forming plants. But this explanation is at once shown to [145] be untenable when the smaller and the larger sacs are proved to be spores or sporangia.

Some, once more, have imagined that coal was of submarine origin; and though the notion is amply and easily refuted by other considerations, it may be worth while to remark, that it is impossible to comprehend how a mass of light and resinous spores should have reached the bottom of the sea, or should have stopped in that position if they had got there.

At the same time, it is proper to remark that I do not presume to suggest that all coal must needs have the same structure; or that there may not be coals in which the proportions of wood and spores, or spore-cases, are very different from those which I have examined. All I repeat is, that none of the coals which have come under my notice have enabled me to observe such a difference. But, according to Principal Dawson, who has so sedulously examined the fossil remains of plants in North America, it is otherwise with the vast accumulations of coal in that country.

The true coal," says Dr. Dawson, "consists principally of the flattened bark of Sigillaroid and other trees, intermixed with leaves of Ferns and *Cordaites,* and other herbaceous *débris,* and with fragments of decayed wood, constituting 'mineral charcoal,' all these materials having manifestly alike grown and accumulated where we find them."[2]

[146] When I had the pleasure of seeing Principal Dawson in London last summer, I showed him my sections of coal, and begged him to re-examine some of the American coals on his return to Canada, with an eye to the presence of spores and sporangia, such as I was able to show him in our English and Scotch coals. He has been good enough to do so; and in a letter dated September 26th, 1870, he informs me that–

Indications of spore-cases are rare, except in certain coarse shaly coals and portions of coals, and in the roofs of the seams. The most marked case I have yet met with is the shaly coal referred to as containing *Sporangites* in my paper on the conditions of accumulation of coal ("Journal of the Geological Society," vol. xxii. pp. 115,139, and 165). The purer coals certainly consist principally of cubical tissues with some true woody matter, and the spore cases, &c., are chiefly in the coarse and shaly layers. This is my old doctrine in my two papers in the "Journal of the Geological Society," and I see nothing to modify it. Your observations, however, make it probable that the frequent *clear spots* in the cannels are spore-cases."

Dr. Dawson's results are the more remarkable, as the numerous specimens of British coal, from various localities, which I have examined, tell one tale as to the predominance of the spore and sporangium element in their composition; and as it is exactly in the finest and purest coals, such as the "Better-Bed" coal of Lowmoor, that the spores and sporangia obviously constitute almost the entire mass of the deposit.

Coal, such as that which has been described, is [147] always found in sheets, or "seams," varying from a fraction of an inch to many feet in thickness, enclosed in the substance of the earth at very various depths, between beds of rock of different kinds. As a rule, every seam of coal rests upon a thicker, or thinner, bed of clay, which is known as "under-clay." These alternations of beds of coal, clay, and rock may be repeated many times, and are known as the "coal-measures"; and in some regions, as in South Wales and in Nova Scotia, the coal-measures attain a thickness of twelve or fourteen thousand feet, and enclose eighty or a hundred seams of coal, each with its under-clay, and separated from those above and below by beds of sandstone and shale.

The position of the beds which constitute the coal-measures is infinitely diverse. Sometimes they are tilted up vertically, sometimes they are horizontal, sometimes curved into great basins; sometimes they come to the surface, sometimes they are covered up by thousands of feet of rock. But, whatever their present position, there is abundant and conclusive evidence that every under-clay was once a surface soil. Not only do carbonized root-fibres frequently abound in these under-clays; but the stools of trees, the trunks of which are broken off and confounded with the bed of coal, have been repeatedly found passing into radiating roots, still embedded in the under-clay. On many parts of the coast of England, what are [148] commonly known as "submarine forests" are to be seen at low water. They consist, for the most part, of short stools of oak, beech, and fir-trees, still fixed by their long roots in the bed of blue clay in which they originally grew. If one of these submarine forest beds should be gradually depressed and covered up by new deposits, it would present just the same characters as an under-clay of the coal, if the *Sigillaria* and *Lepidodendron* of the ancient world were substituted for the oak, or the beech, of our own times.

In a tropical forest, at the present day, the trunks of fallen trees, and the stools of such trees as may have been broken by the violence of storms, remain entire for but a short time. Contrary to what might be expected, the dense wood of the tree decays, and suffers from the ravages of insects, more swiftly than the bark. And the traveller, setting his foot on a prostrate trunk finds that it is a mere shell, which breaks under his weight, and lands his foot amidst the insects, or the reptiles, which have sought food or refuge within.

The trees of the coal forests present parallel conditions. When the fallen trunks which have entered into the composition of the bed of coal are identifiable, they are mere double shells of bark, flattened together in consequence of the destruction of the woody core; and Sir Charles [149] Lyell and Principal Dawson discovered, in the hollow stools of coal trees of Nova Scotia, the remains of snails, millipedes, and salamander-like creatures, embedded in a deposit of a different character from that which surrounded the exterior of the trees. Thus, in endeavouring to comprehend the formation of a seam of coal, we must try to picture to ourselves a thick forest, formed for the most part of trees like gigantic club-mosses, mares'-tails, and tree-ferns, with here and there some that had more resemblance to our existing yews and fir-trees. We must suppose that, as the seasons rolled by, the plants grew and developed their spores and seeds; that they shed these in enormous quantities, which accumulated on the ground beneath; and that, every now and then, they added a dead frond or leaf; or, at longer intervals, a rotten branch, or a dead trunk, to the mass.

A certain proportion of the spores and seeds no doubt fulfilled their obvious function, and, carried by the wind to unoccupied regions, extended the limits of the forest; many might be washed away by rain into streams, and be lost; but a large portion must have remained, to accumulate like beech-mast, or acorns, beneath the trees of a modern forest.

But, in this case, it may be asked, why does not our English coal consist of stems and leaves to a much greater extent than it does? What is [150] the reason of the predominance of the spores and spore-cases in it?

A ready answer to this question is afforded by the study of a living full-grown club-moss. Shake it upon a piece of paper, and it emits a cloud of fine dust, which falls over the paper, and is the well-known Lycopodium powder. Now this powder used to be, and I believe still is, employed for two objects which seem, at first sight, to have no particular connection with one another. It is, or was, employed in making lightning, and in making pills. The coats of the spores contain so much resinous matter, that a pinch of Lycopodium powder, thrown through the flame of a candle, burns with an instantaneous flash, which has long done duty for lightning on the stage. And the same character makes it a capital coating for pills; for the resinous powder prevents the drug from being wetted by the saliva, and thus bars the nauseous flavour from the sensitive papilæ of the tongue.

But this resinous matter, which lies in the walls of the spores and sporangia, is a substance not easily altered by air and water, and hence tends to preserve these bodies, just as the bituminized cerecloth preserves an Egyptian mummy; while, on the other hand, the merely woody stem and leaves tend to rot, as fast as the wood of the mummy's coffin has rotted. Thus the mixed heap of spores, leaves, and stems in the coal-forest would be persistently searched by the long-continued [151] action of air and rain; the leaves and stems would gradually be reduced to little but their carbon, or, in other words, to the condition of mineral charcoal in which we find them; while the spores and sporangia remained as a comparatively unaltered and compact residuum.

There is, indeed, tolerably clear evidence that the coal must, under some circumstances, have been converted into a substance hard enough to be rolled into pebbles, while it yet lay at the surface of the earth; for in some seams of coal, the courses of rivulets, which must have been living water, while the stratum in which their remains are found was still at the surface, have been observed to contain rolled pebbles of the very coal through which the stream has cut its way.

The structural facts are such as to leave no alternative but to adopt the view of the origin of such coal as I have described, which has just been stated; but, happily, the process is not without analogy at the present day. I possess a specimen of what is called "white coal" from Australia. It is an inflammable material, burning with a bright flame, and having much the consistence and appearance of oat-cake, which, I am informed, covers a considerable area. It consists, almost entirely, of a compacted mass of spores and spore-cases. But the fine particles of blown sand which are scattered through it, show that it must [152] have accumulated, subaërially, upon the surface of a soil covered by a forest of

cryptogamous plants, probably tree-ferns.

As regards this important point of the subaërial region of coal, I am glad to find myself in entire accordance with Principal Dawson, who bases his conclusions upon other, but no less forcible, considerations. In a passage, which is the continuation of that already cited, he writes:–

(3) The microscopical structure and chemical composition of the beds of cannel coal and earthly bitumen, and of the more highly bituminous and carbonaceous shale, show them to have been of the nature of the fine vegetable mud which accumulates in the ponds and shallow lakes of modern swamps. When such fine vegetable sediment is mixed, as is often the case, with clay, it becomes similar to the bituminous limestone and calcareo-bituminous shales of the coal-measures. (4) A few of the underclays, which support beds of coal, are of the nature of the vegetable mud above referred to; but the greater part are argillo-arenaceous in composition, with little vegetable matter, and bleached by the drainage from them of water containing the products of vegetable decay. They are, in short, loamy or clay soils, and must have been sufficiently above water to admit of drainage. The absence of sulphurets, and the occurrence of carbonate of lime in connection with them, prove that, when they existed as soils, rain-water, and not sea-water, percolated them. (5) The coal and the fossil forests present many evidences of subaërial conditions. Most of the erect and prostrate trees had become hollow shells of bark before they were finally embedded, and their wood had broken into cubical pieces of mineral charcoal. Land-snails and galley-worms (*Xylobius*) crept into them, and they became dens, or traps, for reptiles. Large quantities of mineral charcoal occur on the surface of all the large beds of coal. None of these appearances could have been produced by subaqueous action. (6) Though the roots of [153] the *Sigillaria* bear more resemblance to the rhizomes of certain aquatic plants; yet, structurally, they are absolutely identical with the roots of Cycads, which the stems also resemble. Further, the *Sigillariæ* grew on the same soils which supported Conifers, *Cordaites,* and Ferns–plants which could not have grown in water. Again, with the exception perhaps of some *Pinnulariæ* and *Asterophyllites,* there is a remarkable absence from the coal measures of any form of properly aquatic vegetation. (7) The occurrence of marine, or brackish water animals, in the roofs of coal beds, or even in the coal itself, affords no evidence of subaqueous accumulation, since the same thing occurs in the case of modern submarine forests. For these and other reasons, some of which are more fully stated in the papers already referred to, while I admit that the areas of coal accumulation were frequently submerged, I must maintain that the true coal is a subaërial accumulation by vegetable growth on soils, wet and swampy it is true, but not submerged."

I am almost disposed to doubt whether it is necessary to make the concession of "wet and swampy"; otherwise, there is nothing that I know of to be said against this excellent conspectus of the reasons for believing in the subaërial origin of coal.

But the coal accumulated upon the area covered by one of the great forests of the carboniferous epoch would, in course of time, have been wasted away by the small, but constant, wear and tear of rain and streams, had the land which supported it remained at the same level, or been gradually raised to a greater elevation. And, no doubt, as much coal as now exists has been destroyed, after its formation, in this way. What are now known [154] as coal districts owe their importance to the fact that they were areas of slow depression, during a greater or less portion of the carboniferous epoch; and that, in virtue of this circumstance, Mother Earth was enabled to cover up her vegetable treasures, and preserve them from destruction.

Wherever a coal-field now exists, there must formerly have been free access for a great river, or for a shallow sea, bearing sediment in the shape of sand and mud. When the coal-forest area became slowly depressed, the waters must have spread over it, and have deposited their burden upon the surface of the bed of coal, in the form of layers, which are now converted into shale, or sandstone. Then followed a period of rest, in which the superincumbent shallow waters became completely filled up, and finally replaced, by fine mud, which settled down into a new under-clay, and furnished the soil for a fresh forest growth. This flourished, and heaped up its spores and wood into coal, until the stage of slow depression recommenced. And, in some localities, as I have mentioned, the process was repeated until the first of the alternating beds had sunk to near three miles below its original level at the surface of the earth.

In reflecting on the statement, thus briefly made, of the main facts connected with the origin of the coal formed during the carboniferous epoch, two or three considerations suggest themselves.

[155] In the first place, the great phantom of geological time rises before the student of this, as of all other, fragments of the history of our earth–springing irrepressibly out of the facts, like the Djin from the jar which the fishermen so incautiously opened; and like the Djin again, being vaporous, shifting, and indefinable, but unmistakably gigantic. However modest the bases of one's calculation may be, the minimum of time assignable to the coal period remains something stupendous.

Principal Dawson is the last person likely to be guilty of exaggeration in this matter, and it will be well to consider what he has to say about it:–

The rate of accumulation of coal vas very slow. The climate of the period, in the northern temperate zone, was of such a character that the true conifers show rings of growth, not larger, nor much less distinct; than those of many of their modern congeners. The *Sigillariæ* and *Calamites* were not, as often supposed, composed wholly, or even principally, of lax and soft tissues, or necessarily short-lived. The former had, it is true, a very thick inner bark; but their dense woody axis, their thick and nearly imperishable outer bark, and their scanty and rigid foliage, would indicate no very rapid growth or decay. In the case of the *Sigillariæ,* the variations in the leaf-scars in different parts of the trunk, the intercalation of new ridges at the surface representing that of new woody wedges in the axis, the transverse marks left by the stages of upward growth, all indicate that several years must have been required for the growth of stems of moderate size. The enormous roots of these trees, and the condition of the coal-swamps, must have exempted them from the danger of being overthrown by violence. They [156] probably fell in successive generations from natural decay; and making every allowance for other materials, we may safely assert that every foot of thickness of pure bituminous coal implies the quiet growth and fall of at least fifty generations of *Sigillariæ,* and therefore an undisturbed condition of forest growth enduring through many centuries. Further, there is evidence that an immense amount of loose parenchymatous tissue, and even of wood, perished by decay, and we do not know to what extent even the most durable tissues may have disappeared in this way; so that, in many coal-scams, we may have only a very small part of the vegetable matter produced."

Undoubtedly the force of these reflections is not diminished when the bituminous coal, as in Britain, consists of accumulated spores and spore-cases, rather than of stems. But, suppose we adopt Principal Dawson's assumption, that one foot of coal represents fifty generations of coal plants; and, further, make the moderate supposition that each generation of coal plants took ten years to come to maturity–then, each foot-thickness of coal represents five hundred years. The superimposed beds of coal in one coal-

field may amount to a thickness of fifty or sixty feet, and therefore the coal alone, in that field, represents 500 x 50 = 25,000 years. But the actual coal is but an insignificant portion of the total deposit, which, as has been seen, may amount to between two and three miles of vertical thickness. Suppose it be 12,000 feet–which is 240 times the thickness of the actual coal–is there any reason why we should believe it may not have taken 240 times as long to form? I know of none. But, in this case, the [157] time which the coal-field represents would be 25,000 x 240 = 6,000,000 years. As affording a definite chronology, of course such calculations as these are of no value; but they have much use in fixing one's attention upon a possible minimum. A man may be puzzled if he is asked how long Rome took a-building; but he is proverbially safe if he affirms it not to have been built in a day; and our geological calculations are all, at present, pretty much on that footing.

A second consideration which the study of the coal brings prominently before the mind of any one who is familiar with palæontology is, that the coal Flora, viewed in relation to the enormous period of time which it lasted, and to the still vaster period which has elapsed since it flourished, underwent little change while it endured, and in its peculiar characters, differs strangely little from that which at present exist.

The same species of plants are to be met with throughout the whole thickness of a coal-field, and the youngest are not sensibly different from the oldest. But more than this. Notwithstanding that the carboniferous period is separated from us by more than the whole time represented by the secondary and tertiary formations, the great types of vegetation were as distinct then as now. The structure of the modern club-moss furnishes a complete explanation of the fossil remains of the *Lepidodendra,* and the fronds of some of the ancient [158] ferns are hard to distinguish from existing ones. At the same time, it must be remembered, that there is nowhere in the world, at present, any *forest* which bears more than a rough analogy with a coal-forest. The types may remain, but the details of their form, their relative proportions, their associates, are all altered. And the tree-fern forest of Tasmania, or New Zealand, gives one only a faint and remote image of the vegetation of the ancient world.

Once more, an invariably-recurring lesson of geological history, at whatever point its study is taken up: the lesson of the almost infinite slowness of the modification of living forms. The lines of the pedigrees of living things break off almost before they begin to converge.

Finally, yet another curious consideration. Let us suppose that one of the stupid, salamander-like Labyrinthodonts, which pottered, with much belly and little leg, like Falstaff in his old age, among the coal-forests, could have had thinking power enough in his small brain to reflect upon the showers of spores which kept on falling through years and centuries, while perhaps not one in ten million fulfilled its apparent purpose, and reproduced the organism which gave it birth: surely he might have been excused for moralizing upon the thoughtless and wanton extravagance which Nature displayed in her operations.

But we have the advantage over our shovel-[159]headed predecessor–or possibly ancestor–and can perceive that a certain vein of thrift runs through this apparent prodigality. Nature is never in a hurry,

and seems to have had always before her eyes the adage, "Keep a thing long enough, and you will find a use for it." She has kept her beds of coal many millions of years without being able to find much use for them; she has sent them down beneath the sea, and the sea-beasts could make nothing of them; she has raised them up into dry land, and laid the black veins bare, and still, for ages and ages, there was no living thing on the face of the earth that could see any sort of value in them; and it was only the other day, so to speak, that she turned a new creature out of her workshop, who by degrees acquired sufficient wits to make a fire, and then to discover that the black rock would burn.

I suppose that nineteen hundred years ago, when Julius Cæsar was good enough to deal with Britain as we have dealt with New Zealand, the primæval Briton, blue with cold and woad, may have known that the strange black stone, of which he found lumps here and there in his wanderings, would burn, and so help to warm his body and cook his food. Saxon, Dane, and Norman swarmed into the land. The English people grew into a powerful nation, and Nature still waited for a full return of the capital she [160] had invested in the ancient club-mosses. The eighteenth century arrived, and with it James Watt. The brain of that man was the spore out of which was developed the modern steam-engine, and all the prodigious trees and branches of modern industry which have grown out of this. But coal is as much an essential condition of this growth and development as carbonic acid is for that of a club-moss. Wanting coal, we could not have smelted the iron needed to make our engines, nor have worked our engines when we had got them. But take away the engines, and the great towns of Yorkshire and Lancashire vanish like a dream. Manufactures give place to agriculture and pasture, and not ten men can live where now ten thousand are amply supported.

Thus, all this abundant wealth of money and of vivid life is Nature's interest upon her investment in club-mosses, and the like, so long ago. But what becomes of the coal which is burnt in yielding this interest? Heat comes out of it, light comes out of it; and if we could gather together all that goes up the chimney, and all that remains in the grate of a thoroughly-burnt coal-fire, we should find ourselves in possession of a quantity of carbonic acid, water, ammonia, and mineral matters, exactly equal in weight to the coal. But these are the very matters with which Nature supplied the club-mosses which made the coal.[161] She is paid back principal and interest at the same time; and she straightway invests the carbonic acid, the water, and the ammonia in new forms of life, feeding with them the plants that now live. Thrifty Nature! Surely no prodigal, but most notable of housekeepers!

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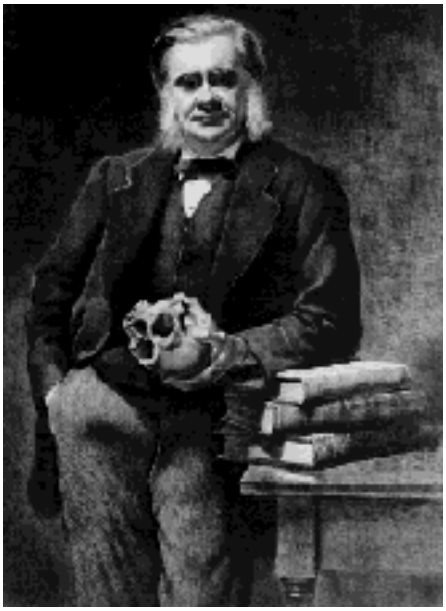
[1] My assistant in the Museum of Practical Geology, Mr. Newton, invented this excellent method of obtaining thin slices of coal.

[2] *Acadian Geology*, 2nd edition, p. 138.

THE HUXLEY FILE



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On the Border Territory Between the Animal and the Vegetable Kingdoms

Macmillan's Magazine (1876)

Collected Essays VIII

[162] In the whole history of science there is nothing more remarkable than the rapidity of the growth of biological knowledge within the last half century, and the extent of the modification which has thereby been effected in some of the fundamental conceptions of the naturalist.

In the second edition of the "Régne Animal," published in 1828, Cuvier devotes a special section to the "Division of Organised Beings into Animals and Vegetables," in which the question is treated with that comprehensiveness of knowledge and clear critical judgment which characterise his writings, and justify us in regarding them as representative expressions of the most extensive, if not the profoundest, knowledge of his time. He tells us that living beings have been sub[163]divided from the earliest times into *animated beings*, which possess sense and motion, and *inanimated beings*, which are devoid of these functions and simply vegetate.

Although the roots of plants direct themselves towards moisture, and their leaves towards air and light,–although the parts of some plants exhibit oscillating movements without any perceptible cause, and the leaves of others retract when touched,–yet none of these movements justify the ascription to plants of perception or of will. From the mobility of animals, Cuvier, with his characteristic partiality for teleological reasoning, deduces the necessity of the existence in them of an alimentary cavity, or reservoir of food, whence their nutrition may be drawn by the vessels, which are a sort of internal roots; and, in the presence of this alimentary cavity, he naturally sees the primary and the most important distinction between animals and plants.

Following out his teleological argument, Cuvier remarks that the organisation of this cavity and its appurtenances must needs vary according to the nature of the aliment, and the operations which it has to undergo, before it can be converted into substances fitted for absorption; while the atmosphere and the earth supply plants with juices ready prepared, and which can be absorbed immediately. As the animal body required to be independent of heat and of the atmosphere, there [164] were no means by which the motion of its fluids could be produced by internal causes. Hence arose the second great distinctive character of animals, or the circulatory system, which is less important than the digestive, since it was unnecessary, and therefore is absent, in the more simple animals.

Animals further needed muscles for locomotion and nerves for sensibility. Hence, says Cuvier, it was necessary that the chemical composition of the animal body should be more complicated than that of the plant; and it is so, inasmuch as an additional substance, nitrogen, enters into it as an essential element; while, in plants, nitrogen is only accidentally joined with the three other fundamental constituents of organic beings–carbon, hydrogen, and oxygen. Indeed, he afterwards affirms that nitrogen is peculiar to

animals; and herein he places the third distinction between the animal and the plant. The soil and the atmosphere supply plants with water, composed of hydrogen and oxygen; air, consisting of nitrogen and oxygen; and carbonic acid, containing carbon and oxygen. They retain the hydrogen and the carbon, exhale the superfluous oxygen, and absorb little or no nitrogen. The essential character of vegetable life is the exhalation of oxygen, which is effected through the agency of light. Animals, on the contrary, derive their nourishment either direct]y or indirectly from plants. They get rid of [165] the superfluous hydrogen and carbon, and accumulate nitrogen. The relations of plants and animals to the atmosphere are therefore inverse. The plant withdraws water and carbonic acid from the atmosphere, the animal contributes both to it. Respiration–that is, the absorption of oxygen and the exhalation of carbonic acid–is the specially animal function of animals, and constitutes their fourth distinctive character.

Thus wrote Cuvier in 1828. But, in the fourth and fifth decades of this century, the greatest and most rapid revolution which biological science has ever undergone was effected by the application of the modern microscope to the investigation of organic structure; by the introduction of exact and easily manageable methods of conducting the chemical analysis of organic compounds; and finally, by the employment of instruments of precision for the measurement of the physical forces which are at work in the living economy.

That the semi-fluid contents (which we now term protoplasm) of the cells of certain plants, such as the *Charæ* are in constant and regular motion, was made out by Bonaventura Corti a century ago; but the fact, important as it was, fell into oblivion, and had to be rediscovered by Treviranus in 1807. Robert Brown noted the more complex motions of the protoplasm in the cells of *Tradescantia* in 1831; and now such movements of the living substance of plants are well [166] known to be some of the most widely-prevalent phenomena of vegetable life.

Agardh, and other of the botanists of Cuvier's generation, who occupied themselves with the lower plants, had observed that, under particular circumstances, the contents of the cells of certain water-weeds were set free, and moved about with considerable velocity, and with all the appearances of spontaneity, as locomotive bodies, which, from their similarity to animals of simple organisation, were called "zoospores." Even as late as 1845, however, a botanist of Schleiden's eminence dealt very sceptically with these statements; and his scepticism was the more justified, since Ehrenberg, in his elaborate and comprehensive work on the *Infusoria*, had declared the greater number of what are now recognised as locomotive plants to be animals.

At the present day, innumerable plants and free plant cells are known to pass the whole or part of their lives in an actively locomotive condition, in no wise distinguishable from that of one of the simpler animals; and, while in this condition, their movements are, to all appearance, as spontaneous–as much the product of volition–as those of such animals.

Hence the teleological argument for Cuvier's first diagnostic character–the presence in animals of an alimentary cavity, or internal pocket, in which they can carry about their nutriment–has [167] broken down, so far, at least, as his mode of stating it goes. And, with the advance of microscopic anatomy, the

universality of the fact itself among animals has ceased to be predicable. Many animals of even complex structure, which live parasitically within others, are wholly devoid of an alimentary cavity. Their food is provided for them, not only ready cooked, but ready digested, and the alimentary canal, become superfluous, has disappeared. Again, the males of most Rotifers have no digestive apparatus; as a German naturalist has remarked, they devote themselves entirely to the "Minnedienst," and are to be reckoned among the few realisations of the Byronic ideal of a lover. Finally, amidst the lowest forms of animal life, the speck of gelatinous protoplasm, which constitutes the whole body, has no permanent digestive cavity or mouth, but takes in its food anywhere; and digests, so to speak, all over its body.

But although Cuvier's leading diagnosis of the animal from the plant will not stand a strict test, it remains one of the most constant of the distinctive characters of animals. And, if we substitute for the possession of an alimentary cavity, the power of taking solid nutriment into the body and there digesting it, the definition so changed will cover all animals, except certain parasites, and the few and exceptional cases of non-parasitic animals which do not feed at all. On the other [168] hand, the definition thus amended will exclude all ordinary vegetable organisms.

Cuvier himself practically gives up his second distinctive mark when he admits that it is wanting in the simpler animals.

The third distinction is based on a completely erroneous conception of the chemical differences and resemblances between the constituents of animal and vegetable organisms, for which Cuvier is not responsible, as it was current among contemporary chemists. It is now established that nitrogen is as essential a constituent of vegetable as of animal living matter; and that the latter is, chemically speaking, just as complicated as the former. Starchy substances, cellulose and sugar, once supposed to be exclusively confined to plants, are now known to be regular and normal products of animals. Amylaceous and saccharine substances are largely manufactured, even by the highest animals; cellulose is widespread as a constituent of the skeletons of the lower animals; and it is probable that amyloid substances are universally present in the animal organism, though not in the precise form of starch.

Moreover, although it remains true that there is an inverse relation between the green plant in sunshine and the animal, in so far as, under these circumstances, the green plant decomposes carbonic acid and exhales oxygen, while the animal absorbs oxygen and exhales carbonic acid; yet, [169] the exact researches of the modern chemical investigators of the physiological processes of plants have clearly demonstrated the fallacy of attempting to draw any general distinction between animals and vegetables on this ground. In fact, the difference vanishes with the sunshine, even in the case of the green plant; which, in the dark, absorbs oxygen and gives out carbonic acid like any animal.[1] On the other hand, those plants, such as the fungi, which contain no chlorophyll and are not green, are always, so far as respiration is concerned, in the exact position of animals. They absorb oxygen and give out carbonic acid.

Thus, by the progress of knowledge, Cuvier's fourth distinction between the animal and the plant has been as completely invalidated as the third and second; and even the first can be retained only in a

modified form and subject to exceptions.

But has the advance of biology simply tended to break down old distinctions, without establishing new ones?

With a qualification, to be considered presently, the answer to this question is undoubtedly in the affirmative. The famous researches of Schwann [170] and Schleiden in 1837 and the following years, founded the modern science of histology, or that branch of anatomy which deals with the ultimate visible structure of organisms, as revealed by the microscope; and, from that day to this, the rapid improvement of methods of investigation, and the energy of a host of accurate observers, have given greater and greater breadth and firmness to Schwann's great generalisation, that a fundamental unity of structure obtains in animals and plants; and that, however diverse may be the fabrics, or *tissues,* of which their bodies are composed, all these varied structures result from the metamorphosis of morphological units (termed *cells*, in a more general sense than that in which the word "cells" was at first employed), which are not only similar in animals and in plants respectively, but present a close resemblance, when those of animals and those of plants are compared together.

The contractility which is the fundamental condition of locomotion, has not only been discovered to exist far more widely among plants than was formerly imagined; but, in plants, the act of contraction has been found to be accompanied, as Dr. Burdon Sanderson's interesting investigations have shown, by a disturbance of the electrical state of the contractile substance, comparable to that which was found by Du Bois Reymond to be a concomitant of the activity of ordinary muscle in animals.

[171] Again, I know of no test by which the reaction of the leaves of the Sundew and of other plants to stimuli, so fully and carefully studied by Mr. Darwin, can be distinguished from those acts of contraction following upon stimuli, which are called "reflex" in animals.

On each lobe of the bilobed leaf of Venus's flytrap (*Dionæa muscipula*) are three delicate filaments which stand out at right angle from the surface of the leaf. Touch one of them with the end of a fine human hair and the lobes of the leaf instantly close together[2] in virtue of an act of contraction of part of their substance, just as the body of a snail contracts into its shell when one of its "horns" is irritated.

The reflex action of the snail is the result of the presence of a nervous system in the animal. A molecular change takes place in the nerve of the tentacle, is propagated to the muscles by which the body is retracted, and causing them to contract, the act of retraction is brought about. Of course the similarity of the acts does not necessarily involve the conclusion that the mechanism by which they are effected is the same; but it suggests a suspicion of their identity which needs careful testing.

The results of recent inquiries into the structure of the nervous system of animals converge towards the conclusion that the nerve fibres, which we [172] have hitherto regarded as ultimate elements of nervous tissue, are not such, but are simply the visible aggregations of vastly more attenuated filaments, the diameter of which dwindles down to the limits of our present microscopic vision, greatly as these have

been extended by modern improvements of the microscope; and that a nerve is, in its essence, nothing but a linear tract of specially modified protoplasm between two points of an organism–one of which is able to affect the other by means of the communication so established. Hence, it is conceivable that even the simplest living being may possess a nervous system. And the question whether plants are provided with a nervous system or not, thus acquires a new aspect, and presents the histologist and physiologist with a problem of extreme difficulty, which must be attacked from a new point of view and by the aid of methods which have yet to be invented.

Thus it must be admitted that plants may be contractile and locomotive; that, while locomotive, their movements may have as much appearance of spontaneity as those of the lowest animals; and that many exhibit actions, comparable to those which are brought about by the agency of a nervous system in animals. And it must be allowed to be possible that further research may reveal the existence of something comparable to a nervous system in plants. So that I know not where we can hope to find any absolute distinction [173] between animals and plants, unless we return to their mode of nutrition, and inquire whether certain differences of a more occult character than those imagined to exist by Cuvier, and which certainly hold good for the vast majority of animals and plants, are of universal application.

A bean may be supplied with water in which salts of ammonia and certain other mineral salts are dissolved in due proportion; with atmospheric air containing its ordinary minute dose of carbonic acid; and with nothing else but sunlight and heat. Under these circumstances, unnatural as they are, with proper management, the bean will thrust forth its radicle and its plumule; the former will grow down into roots, the latter grow up into the stem and leaves of a vigorous bean-plant; and this plant will, in due time, flower and produce its crop of beans, just as if it were grown in the garden or in the field.

The weight of the nitrogenous protein compounds, of the oily, starchy, saccharine and woody substances contained in the full-grown plant and its seeds, will be vastly greater than the weight of the same substances contained in the bean from which it sprang. But nothing has been supplied to the bean save water, carbonic acid, ammonia, potash, lime, iron, and the like, in combination with phosphoric, sulphuric, and other acids. Neither protein, nor fat, nor starch, nor sugar, nor any substance in the slightest degree resembling them, has formed part [174] of the food of the bean. But the weights of the carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, and other elementary bodies contained in the bean-plant, and in the seeds which it produces, are exactly equivalent to the weights of the same elements which have disappeared from the materials supplied to the bean during its growth. Whence it follows that the bean has taken in only the raw materials of its fabric, and has manufactured them into bean-stuffs.

The bean has been able to perform this great chemical feat by the help of its green colouring matter, or chlorophyll; for it is only the green parts of the plant which, under the influence of sunlight, have the marvellous power of decomposing carbonic acid, setting free the oxygen and laying hold of the carbon which it contains. In fact, the bean obtains two of the absolutely indispensable elements of its substance from two distinct sources; the watery solution, in which its roots are plunged, contains nitrogen but no carbon; the air, to which the leaves are exposed, contains carbon, but its nitrogen is in the state of a free

gas, in which condition the bean can make no use of it;[3] and the chlorophyll[4] is the apparatus by which the carbon is extracted from the atmospheric carbonic acid–the leaves being the chief laboratories in which this operation is effected.

The great majority of conspicuous plants are, as everybody knows, green; and this arises from the abundance of their chlorophyll. The few which contain no chlorophyll and are colourless, are unable to extract the carbon which they require from atmospheric carbonic acid, and lead a parasitic existence upon other plants; but it by no means follows, often as the statement has been repeated, that the manufacturing power of plants depends on their chlorophyll, and its interaction with the rays of the sun. On the contrary, it is easily demonstrated, as Pasteur first proved, that the lowest fungi, devoid of chlorophyll, or of any substitute for it, as they are, nevertheless possess the characteristic manufacturing powers of plants in a very high degree. Only it is necessary that they should be supplied with a different kind of raw material; as they cannot extract carbon from carbonic acid, they must be furnished with something else that contains carbon. Tartaric acid is such a substance; and if a single spore of the commonest and most troublesome of moulds–*Penicillium*–be sown in a saucerful of water, in which tartrate of ammonia, with a small percentage of phosphates and sulphates is contained, and kept warm, whether in the dark or exposed to light, it will, in a short time, give rise to a thick crust of mould, [176] which contains many million times the weight of the original spore, in protein compounds and cellulose. Thus we have a very wide basis of fact for the generalisation that plants are essentially characterised by their manufacturing capacity–by their power of working up mere mineral matters into complex organic compounds.

Contrariwise, there is a no less wide foundation for the generalisation that animals, as Cuvier puts it, depend directly or indirectly upon plants for the materials of their bodies; that is, either they are herbivorous, or they eat other animals which are herbivorous.

But for what constituents of their bodies are animals thus dependent upon plants? Certainly not for their horny matter; nor for chondrin, the proximate chemical element of cartilage; nor for gelatine; nor for syntonin, the constituent of muscle; nor for their nervous or biliary substances; nor for their amyloid matters; nor, necessarily, for their fats.

It can be experimentally demonstrated that animals can make these for themselves. But that which they cannot make, but must, in all known cases, obtain directly or indirectly from plants, is the peculiar nitrogenous matter, protein. Thus the plant is the ideal *prolétaire* of the living world, the worker who produces; the animal, the ideal aristocrat, who mostly occupies himself in consuming, after the manner of that noble repre[177]sentative of the line of Zähdarm, whose epitaph is written in "Sartor Resartus."

Here is our last hope of finding a sharp line of demarcation between plants and animals; for, as I have already hinted, there is a border territory between the two kingdoms, a sort of no-man's-land, the inhabitants of which certainly cannot be discriminated and brought to their proper allegiance in any other way.

Some months ago, Professor Tyndall asked me to examine a drop of infusion of hay, placed under an excellent and powerful microscope, and to tell him what I thought some organisms visible in it were. I looked and observed, in the first place, multitudes of *Bacteria* moving about with their ordinary intermittent spasmodic wriggles. As to the vegetable nature of these there is now no doubt. Not only does the close resemblance of the *Bacteria* to unquestionable plants, such as the *Oscillatoriæ* and the lower forms of *Fungi,* justify this conclusion, but the manufacturing test settles the question at once. It is only needful to add a minute drop of fluid containing *Bacteria,* to water in which tartrate, phosphate, and sulphate of ammonia are dissolved; and, in a very short space of time, the clear fluid becomes milky by reason of their prodigious multiplication, which, of course, implies the manufacture of living Bacterium-stuff out of these merely saline matters.

[178] But other active organisms, very much larger than the *Bacteria,* attaining in fact the comparatively gigantic dimensions of 1/3000th of an inch or more, incessantly crossed the field of view. Each of these had a body shaped like a pear, the small end being slightly incurved and produced into a long curved filament, or *cilium,* of extreme tenuity. Behind this, from the concave side of the incurvation, proceeded another long cilium, so delicate as to be discernible only by the use of the highest powers and careful management of the light. In the centre of the pear-shaped body a clear round space could occasionally be discerned, but not always; and careful watching showed that this clear vacuity appeared gradually, and then shut up and disappeared suddenly, at regular intervals. Such a structure is of common occurrence among the lowest plants and animals, and is known as a *contractile vacuole.*

The little creature thus described sometimes propelled itself with great activity, with a curious rolling motion, by the lashing of the front cilium, while the second cilium trailed behind; sometimes it anchored itself by the hinder cilium and was spun round by the working of the other, its motions resembling those of an anchor buoy in a heavy sea. Sometimes, when two were in full career towards one another, each would appear dexterously to get out of the other's way; sometimes a crowd would assemble and jostle one [179] another, with as much semblance of individual effort as a spectator on the Grands Mulets might observe with a telescope among the specks representing men in the valley of Chamounix.

The spectacle, though always surprising, was not new to me. So my reply to the question put to me was, that these organisms were what biologists call *Monads,* and though they might be animals, it was also possible that they might, like the *Bacteria,* be plants. My friend received my verdict with an expression which showed a sad want of respect for authority. He would as soon believe that a sheep was a plant. Naturally piqued by this want of faith, I have thought a good deal over the matter; and, as I still rest in the lame conclusion I originally expressed, and must even now confess that I cannot certainly say whether this creature is an animal or a plant, I think it may be well to state the grounds of my hesitation at length. But, in the first place, in order that I may conveniently distinguish this "Monad" from the multitude of other things which go by the same designation, I must give it a name of its own. I think (though, for reasons which need not be stated at present, I am not quite sure) that it is identical with the species *Monas lens,* as defined by the eminent French microscopist Dujardin, though his magnifying power was probably insufficient to enable him to see that it is curiously like a much larger [180] form of monad which he has named *Heteromita.* I shall, therefore, call it not *Monas,* but *Heteromita lens.*

I have been unable to devote to my *Heteromita* the prolonged study needful to work out its whole history, which would involve weeks, or it may be months, of unremitting attention. But I the less regret this circumstance, as some remarkable observations recently published by Messrs. Dallinger and Drysdale[5] on certain Monads, relate, in part, to a form so similar to my *Heteromita lens,* that the history of the one may be used to illustrate that of the other. These most patient and painstaking observers, who employed the highest attainable powers of the microscope and, relieving one another, kept watch day and night over the same individual monads, have been enabled to trace out the whole history of their *Heteromita;* which they found in infusions of the heads of fishes of the cod tribe.

Of the four monads described and figured by these investigators, one, as I have said, very closely resembles *Heteromita lens* in every particular, except that it has a separately distinguishable central particle or "nucleus," which is not certainly to be made out in *Heteromita lens;* and that nothing is said by Messrs. Dallinger [181] and Drysdale of the existence of a contractile vacuole in this monad, though they describe it in another.

Their *Heteromita,* however, multiplied rapidly by fission. Sometimes a transverse constriction appeared; the hinder half developed a new cilium, and the hinder cilium gradually split from its base to its free end, until it was divided into two; a process which, considering the fact that this fine filament cannot be much more than 1/100000th of an inch in diameter, is wonderful enough. The constriction of the body extended inwards until the two portions were united by a narrow isthmus; finally, they separated and each swam away by itself, a complete *Heteromita,* provided with its two cilia. Sometimes the constriction took a longitudinal direction, with the same ultimate result. In each case the process occupied not more than six or seven minutes. At this rate, a single *Heteromita* would give rise to a thousand like itself in the course of an hour to about a million in two hours, and to a number greater than the generally assumed number of human beings now living in the world in three hours; or, if we give each *Heteromita* an hour's enjoyment of individual existence, the same result will be obtained in about a day. The apparent suddenness of the appearance of multitudes of such organisms as these, in any nutritive fluid to which one obtains access, is thus easily explained.

[182] During these processes of multiplication by fission, the *Heteromita* remains active; but sometimes another mode of fission occurs. The body becomes rounded and quiescent, or nearly so; and, while in this resting state, divides into two portions, each of which is rapidly converted into an active *Heteromita.*

A still more remarkable phenomenon is that kind of multiplication which is preceded by the union of two monads, by a process which is termed *Conjugation.* Two active *Heteromitæ* become applied to one another, and then slowly and gradually coalesce into one body. The two nuclei run into one; and the mass resulting from the conjugation of the two *Heteromitæ,* thus fused together, has a triangular form. The two pairs of cilia are to be seen, for some time, at two of the angles, which answer to the small ends of the conjoined monads; but they ultimately vanish, and the twin organism, in which all visible traces of organisation have disappeared, falls into a state of rest. Sudden wave-like movements of its substance next occur; and, in a short time, the apices of the triangular mass burst, and give exit to a dense yellowish, glairy fluid, filled with minute granules. This process, which, it will be observed, involves the

actual confluence and mixture of the substance of two distinct organisms, is effected in the space of about two hours.

The authors whom I quote say, that they [183] "cannot express" the excessive minuteness of the granules in question, and they estimate their diameter at less than 1/200000 thof an inch. Under the highest powers of the microscope, at present applicable, such specks are hardly discernible. Nevertheless, particles of this size are massive when compared to physical molecules; whence there is no reason to doubt that each, small as it is, may have a molecular structure sufficiently complex to give rise to the phenomena of life. And, as a matter of fact, by patient watching of the place at which these infinitesimal living particles were discharged, our observers assured themselves of their growth and development into new monads. In about four hours from their being set free, they had attained a sixth of the length of the parent, with the characteristic cilia, though at first they were quite motionless; and, in four hours more, they had attained the dimensions and exhibited all the activity of the adult. These inconceivably minute particles are therefore the germs of the *Heteromita;* and from the dimensions of these germs it is easily shown that the body formed by conjugation may, at a low estimate, have given exit to thirty thousand of them; a result of a matrimonial process whereby the contracting parties, without a metaphor, "become one flesh," enough to make a Malthusian despair of the future of the Universe.

I am not aware that the investigators from [184] whom I have borrowed this history have endeavoured to ascertain whether their monads take solid nutriment or not; so that though they help us very much to fill up the blanks in the history of my *Heteromita,* their observations throw no light on the problem we are trying to solve–Is it an animal or is it a plant?

Undoubtedly it is possible to bring forward very strong arguments in favour of regarding *Heteromita* as a plant.

For example, there is a Fungus, an obscure and almost microscopic mould, termed *Peronospora infestans.* Like many other Fungi, the *Peronosporæ* are parasitic upon other plants; and this particular *Peronospora* happens to have attained much notoriety and political importance, in a way not without a parallel in the career of notorious politicians, namely, by reason of the frightful mischief it has done to mankind. For it is this *Fungus* which is the cause of the potato disease; and, therefore, *Peronospora infestans* (doubtless of exclusively Saxon origin, though not accurately known to be so) brought about the Irish famine. The plants afflicted with the malady are found to be infested by a mould, consisting of fine tubular filaments, termed *hyphæ,* which burrow through the substance of the potato plant, and appropriate to themselves the substance of their host; while, at the same time, directly or indirectly, they set up chemical changes by which even its woody [185] framework becomes blackened, sodden, and withered.

In structure, however, the *Peronospora* is as much a mould as the common *Penicillium;* and just as the *Penicillium* multiplies by the breaking up of its hyphæ into separate rounded bodies, the spores; so, in the *Peronospora,* certain of the hyphæ grow out into the air through the interstices of the superficial cells of the potato plant, and develop spores. Each of these hyphæ usually gives off several branches.

The ends of the branches dilate and become closed sacs, which eventually drop off as spores. The spores falling on some part of the same potato plant, or carried by the wind to another, may at once germinate, throwing out tubular prolongations which become hyphæ, and burrow into the substance of the plant attacked. But, more commonly, the contents of the spore divide into six or eight separate portions. The coat of the spore gives way, and each portion then emerges as an independent organism, which has the shape of a bean, rather narrower at one end than the other, convex on one side, and depressed or concave on the opposite. From the depression, two long and delicate cilia proceed, one shorter than the other, and directed forwards. Close to the origin of these cilia, in the substance of the body, is a regularly pulsating, contractile vacuole. The shorter cilium vibrates actively, and effects the locomotion of the organ[186] ism, while the other trails behind; the whole body rolling on its axis with its pointed end forwards.

The eminent botanist, De Bary, who was not thinking of our problem, tells us, in describing the movements of these "Zoospores," that, as they swim about, "Foreign bodies are carefully avoided, and the whole movement has a deceptive likeness to the voluntary changes of place which are observed in microscopic animals."

After swarming about in this way in the moisture on the surface of a leaf or stem (which, film though it may be, is an ocean to such a fish) for half an hour, more or less, the movement of the zoospore becomes slower, and is limited to a slow turning upon its axis, without change of place. It then becomes quite quiet, the cilia disappear, it assumes a spherical form, and surrounds itself with a distinct, though delicate, membranous coat. A protuberance then grows out from one side of the sphere, and rapidly increasing in length, assumes the character of a hypha. The latter penetrates into the substance of the potato plant, either by entering a stomate, or by boring through the wall of an epidermic cell, and ramifies, as a mycelium, in the substance of the plant, destroying the tissues with which it comes in contact. As these processes of multiplication take place very rapidly, millions of spores are soon set free from a single infested plant; and, from their minuteness, [187] they are readily transported by the gentlest breeze. Since, again, the zoospores set free from each spore, in virtue of their powers of locomotion, swiftly disperse themselves over the surface, it is no wonder that the infection, once started, soon spreads from field to field, and extends its ravages over a whole country.

However, it does not enter into my present plan to treat of the potato disease, instructively as its history bears upon that of other epidemics; and I have selected the case of the *Peronospora* simply because it affords an example of an organism, which, in one stage of its existence, is truly a "Monad," indistinguishable by any important character from our *Heteromita,* and extraordinarily like it in some respects. And yet this "Monad" can be traced, step by step, through the series of metamorphoses which I have described, until it assumes the features of an organism, which is as much a plant as is an oak or an elm.

Moreover, it would be possible to pursue the analogy farther. Under certain circumstances, a process of conjugation takes place in the *Peronospora.* Two separate portions of its protoplasm become fused together, surround themselves with a thick coat, and give rise to a sort of vegetable egg called an *oospore.* After a period of rest, the contents of the oospore break up into a number of zoospores like those already described, each of which, after a period of activity, germinates in the [188] ordinary way.

This process obviously corresponds with the conjugation and subsequent setting free of germs in the *Heteromita.*

But it may be said that the *Peronospora* is, after all, a questionable sort of plant; that it seems to be wanting in the manufacturing power, selected as the main distinctive character of vegetable life; or, at any rate, that there is no proof that it does not get its protein matter ready made from the potato plant.

Let us, therefore, take a case which is not open to these objections.

There are some small plants known to botanists as members of the genus *Coleochæte,* which, without being truly parasitic, grow upon certain water-weeds, as lichens grow upon trees. The little plant has the form of an elegant green star, the branching arms of which are divided into cells. Its greenness is due to its chlorophyll, and it undoubtedly has the manufacturing power in full degree, decomposing carbonic acid and setting oxygen free, under the influence of sunlight. But the protoplasmic contents of some of the cells of which the plant is made up occasionally divide, by a method similar to that which effects the division of the contents of the *Peronospora* spore; and the severed portions are then set free as active monad-like zoospores. Each is oval and is provided at one extremity with two long active cilia. Propelled by these, it swims about for a longer or [189] shorter time, but at length comes to a state of rest and gradually grows into a *Coleochæte.* Moreover, as in the *Peronospora,* conjugation may take place and result in an oospore; the contents of which divide and are set free as monadiform germs.

If the whole history of the zoospores of *Peronospora* and of *Coleochæte* were unknown, they would undoubtedly be classed among "Monads" with the same right as *Heteromita;* why then may not *Heteromita* be a plant, even though the cycle of forms through which it passes shows no terms quite so complex as those which occur in *Peronospora* and *Coleochæte*? And, in fact, there are some green organisms, in every respect characteristically plants, such as *Chlamydomonas,* and the common *Volvox,* or so-called "Globe animalcule," which run through a cycle of forms of just the same simple character as those of *Heteromita.*

The name of *Chlamydomonas* is applied to certain microscopic green bodies, each of which consists of a protoplasmic central substance invested by a structureless sac. The latter contains cellulose, as in ordinary plants; and the chlorophyll which gives the green colour enables the *Chlamydomonas* to decompose carbonic acid and fix carbon as they do. Two long cilia protrude through the cell-wall, and effect the rapid locomotion of this "monad," which, in all respects except its mobility, is [190] characteristically a plant. Under ordinary circumstances, the *Chlamydomonas* multiplies by simple fission, each splitting into two or into four parts, which separate and become independent organisms. Sometimes, however, the *Chlamydomonas* divides into eight parts, each of which is provided with four instead of two cilia. These "zoospores" conjugate in pairs, and give rise to quiescent bodies, which multiply by division, and eventually pass into the active state.

Thus, so far as outward form and the general character of the cycle of modifications, through which the organism passes in the course of its life, are concerned, the resemblance between *Chlamydomonas* and

Heteromita is of the closest description. And on the face of the matter there is no ground for refusing to admit that *Heteromita* may be related to *Chlamydomonas,* as the colourless fungus is to the green alga. *Volvox* may be compared to a hollow sphere, the wall of which is made up of coherent Chlamydomonads; and which progresses with a rotating motion effected by the paddling of the multitudinous pairs of cilia which project from its surface. Each *Volvox*-monad, moreover, possesses a red pigment spot, like the simplest form of eye known among animals. The methods of fissive multiplication and of conjugation observed in the monads of this locomotive globe are essentially similar to those observed in *Chlamydomonas;* and, though a hard battle has been [191] fought over it, *Volvox* is now finally surrendered to the Botanists.

Thus there is really no reason why *Heteromita* may not be a plant; and this conclusion would be very satisfactory, if it were not equally easy to show that there is really no reason why it should not be an animal. For there are numerous organisms presenting the closest resemblance to *Heteromita,* and, like it, grouped under the general name of "Monads," which, nevertheless, can be observed to take in solid nutriment, and which, therefore, have a virtual, if not an actual, mouth and digestive cavity, and thus come under Cuvier's definition of an animal. Numerous forms of such animals have been described by Ehrenberg, Dujardin, H. James Clark, and other writers on the *Infusoria.* Indeed, in another infusion of hay in which my *Heteromita lens* occurred, there were innumerable such infusorial animalcules belonging to the well-known species *Colpoda cucullus.*[6]

Full-sized specimens of this animalcule attain a length of between 1/300th or 1/400th of an inch, so that it may have ten times the length and a thousand times the mass of a *Heteromita.* In shape, it is not altogether unlike *Heteromita.* The small end, however, is not produced into one long cilium, but the general surface of the body is covered with [192] small actively vibrating ciliary organs, which are only longest at the small end. At the point which answers to that from which the two cilia arise in *Heteromita,* there is a conical depression, the mouth; and, in young specimens, a tapering filament, which reminds one of the posterior cilium of *Heteromita,* projects from this region.

The body consists of a soft granular protoplasmic substance, the middle of which is occupied by a large oval mass called the "nucleus"; while, at its hinder end, is a "contractile vacuole," conspicuous by its regular rhythmic appearances and disappearances. Obviously, although the *Colpoda* is not a monad, it differs from one only in subordinate details. Moreover, under certain conditions, it becomes quiescent, encloses itself in a delicate case or *cyst,* and then divides into two, four, or more portions, which are eventually set free and swim about as active *Colpodæ.*

But this creature is an unmistakable animal, and full-sized *Colpodæ,* may be fed as easily as one feeds chickens. It is only needful to diffuse very finely ground carmine through the water in which they live, and, in a very short time, the bodies of the *Colpodæ* are stuffed with the deeply-coloured granules of the pigment.

And if this were not sufficient evidence of the animality of *Colpoda,* there comes the fact that it is even more similar to another well-known animalcule, *Paramœcium,* than it is to a monad. [193] But

paramœcium is so huge a creature compared with those hitherto discussed–it reaches 1/120th of an inch or more in length–that there is no difficulty in making out its organisation in detail; and in proving that it is not only an animal, but that it is an animal which possesses a somewhat complicated organisation. For example, the surface layer of its body is different in structure from the deeper parts. There are two contractile vacuoles, from each of which radiates a system of vessel-like canals; and not only is there a conical depression continuous with a tube, which serve as mouth and gullet, but the food ingested takes a definite course, and refuse is rejected from a definite region. Nothing is easier than to feed these animals, and to watch the particles of indigo or carmine accumulate at the lower end of the gullet. From this they gradually project, surrounded by a ball of water, which at length passes with a jerk, oddly simulating a gulp, into the pulpy central substance of the body, there to circulate up one side and down the other, until its contents are digested and assimilated. Nevertheless, this complex animal multiplies by division, as the monad does, and, like the monad, undergoes conjugation. It stands in the same relation to *Heteromita* on the animal side, as *Coleochæte* does on the plant side. Start from either, and such an insensible series of gradations leads to the monad that it is impossible to say at any stage of the [194] progress where the line between the animal and the plant must be drawn.

There is reason to think that certain organisms which pass through a monad stage of existence, such as the *Myxomycetes,* are, at one time of their lives, dependent upon external sources for their protein matter, or are animals; and, at another period, manufacture it, or are plants. And seeing that the whole progress of modern investigation is in favour of the doctrine of continuity, it is a fair and probable speculation–though only a speculation–that, as there are some plants which can manufacture protein out of such apparently intractable mineral matters as carbonic acid, water, nitrate of ammonia, metallic and earthy salts; while others need to be supplied with their carbon and nitrogen in the somewhat less raw form of tartrate of ammonia and allied compounds; so there may be yet others, as is possibly the case with the true parasitic plants, which can only manage to put together materials still better prepared–still more nearly approximated to protein–until we arrive at such organisms as the *Psorospermiæ* and the *Panhistophyton*, which are as much animal as vegetable in structure, but are animal in their dependence on other organisms for their food.

The singular circumstance observed by Meyer, that the *Tortula* of yeast, though an indubitable plant, still flourishes most vigorously when supplied with the complex nitrogenous substance, pepsin; [195] the probability that the *Peronospora* is nourished directly by the protoplasm of the potato-plant; and the wonderful facts which have recently been brought to light respecting insectivorous plants, all favour this view; and tend to the conclusion that the difference between animal and plant is one of degree rather than of kind, and that the problem whether, in a given case, an organism is an animal or a plant, may be essentially insoluble.

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[1] There is every reason to believe that living plants, like living animals, always respire, and, in respiring, absorb oxygen and give off carbonic acid; but, that in green plants exposed to daylight or to the electric light, the quantity of oxygen evolved in consequence of the decomposition of carbonic acid by a special apparatus which green plants possess exceeds that absorbed in the concurrent respiratory process.

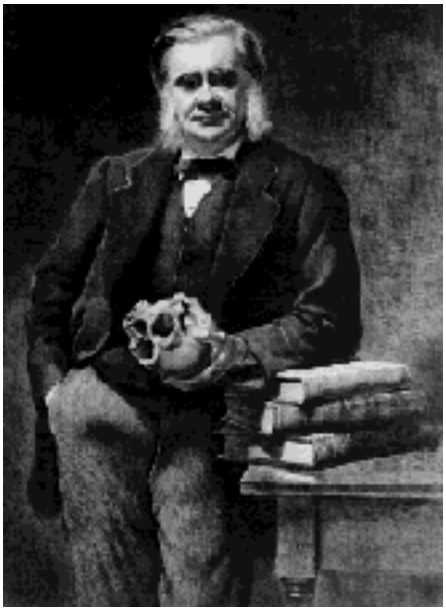
[2] Darwin, *Insectivorous Plants*, p. 289.

[3] I purposely assume that the air with which the bean is supplied in the case stated contains no ammoniacal salts.

[4] The recent researches of Pringsheim have raised a host of questions as to the exact share taken by chlorophyll in the chemical operations which are effected by the green parts of plants. It may be that the chlorophyll is only a constant concomitant of the actual deoxidising apparatus.

[5] "Researches in the Life-history of a Cercomonad: a Lesson in Biogenesis"; and "Further Researches in the Life-history of the Monads."–*Monthly Microscopical Journal*, 1873.

[6] Excellently described by Stein, almost all of whose statements I have verified.



A Lobster; or, the Study of Zoology

Lay Sermons (1861)

Collected Essays VIII

[196] Natural History is the name familiarly applied to the study of the properties of such natural bodies as minerals, plants, and animals; the sciences which embody the knowledge man has acquired upon these subjects are commonly termed Natural Sciences, in contradistinction to other so-called "physical" sciences; and those who devote themselves especially to the pursuit of such sciences have been and are commonly termed "Naturalists."

Linnæus was a naturalist in this wide sense, and his "Systema Naturæ" was a work upon natural history, in the broadest acceptation of the term; in it, that great methodising spirit embodied all that was known in his time of the distinctive characters of minerals, animals, and [191] plants. But the enormous stimulus which Linnæus gave to the investigation of nature soon rendered it impossible that any one man should write another "Systema Naturæ," and extremely difficult for any one to become even a naturalist such as Linnæus was.

Great as have been the advances made by all the three branches of science, of old included under the title of natural history, there can be no doubt that zoology and botany have grown in an enormously greater ratio than mineralogy; and hence, as I suppose, the name of "natural history" has gradually become more and more definitely attached to these prominent divisions of the subject, and by "naturalist" people have meant more and more distinctly to imply a student of the structure and function of living beings.

However this may be, it is certain that the advance of knowledge has gradually widened the distance between mineralogy and its old associates, while it has drawn zoology and botany closer together; so that of late years it has been found convenient (and indeed necessary) to associate the sciences which deal with vitality and all its phenomena under the common head of "biology"; and the biologists have come to repudiate any blood-relationship with their foster-brothers, the mineralogists.

Certain broad laws have a general application throughout both the animal and the vegetable [197] worlds, but the ground common to these kingdoms of nature is not of very wide extent, and the multiplicity of details is so great, that the student of living beings finds himself obliged to devote his attention exclusively either to the one or the other. If he elects to study plants, under any aspect, we know at once what to call him. He is a botanist, and his science is botany. But if the investigation of animal life be his choice, the name generally applied to him will vary according to the kind of animals he studies, or the particular phenomena of animal life to which he confines his attention. If the study of man is his object, he is called an anatomist, or a physiologist, or an ethnologist; but if he dissects animals, or examines into the mode in which their functions are performed, he is a comparative

anatomist or comparative physiologist. If he turns his attention to fossil animals, he is a palæontologist. If his mind is more particularly directed to the specific description, discrimination, classification, and distribution of animals, he is termed a zoologist.

For the purpose of the present discourse, however, I shall recognise none of these titles save the last, which I shall employ as the equivalent of botanist, and I shall use the term zoology as denoting the whole doctrine of animal life, in contradistinction to botany, which signifies the whole doctrine of vegetable life.

Employed in this sense, zoology, like botany, is [193] divisible into three great but subordinate sciences, morphology, physiology, and distribution, each of which may, to a very great extent, be studied independently of the other.

Zoological morphology is the doctrine of animal form or structure. Anatomy is one of its branches; development is another; while classification is the expression of the relations which different animals bear to one another, in respect of their anatomy and their development.

Zoological distribution is the study of animals in relation to the terrestrial conditions which obtain now, or have obtained at any previous epoch of the earth's history.

Zoological physiology, lastly, is the doctrine of the functions or actions of animals. It regards animal bodies as machines impelled by certain forces, and performing an amount of work which can be expressed in terms of the ordinary forces of nature. The final object of physiology is to deduce the facts of morphology, on the one hand, and those of distribution on the other, from the laws of the molecular forces of matter.

Such is the scope of zoology. But if I were to content myself with the enunciation of these dry definitions, I should ill exemplify that method of teaching this branch of physical science, which it is my chief business to-night to recommend. Let us turn away then from abstract definitions. Let us take some concrete living thing, some animal, the [200] commoner the better, and let us see how the application of common sense and common logic to the obvious facts it presents, inevitably leads us into all these branches of zoological science.

I have before me a lobster. When I examine it, what appears to be the most striking character it presents? Why, I observe that this part which we call the tail of the lobster, is made up of six distinct hard rings and a seventh terminal piece. If I separate one of the middle rings, say the third, I find it carries upon its under surface a pair of limbs or appendages, each of which consists of a stalk and two terminal pieces. So that I can represent a transverse section of the ring and its appendages upon the diagram board in this way.

If I now take the fourth ring, I find it has the same structure, and so have the fifth and the second; so that, in each of these divisions of the tail, I find parts which correspond with one another, a ring and two

appendages; and in each appendage a stalk and two end pieces. These corresponding parts are called, in the technical language of anatomy, "homologous parts." The ring of the third division is the "homologue" of the ring of the fifth, the appendage of the former is the homologue of the appendage of the latter. And, as each division exhibits corresponding parts in corresponding places, we say that all the divisions are constructed upon the same plan. But now let us consider the sixth division. It is similar to, [201] and yet different from, the others. The ring is essentially the same as in the other divisions; but the appendages look at first as if they were very different; and yet when we regard them closely, what do we find? A stalk and two terminal divisions, exactly as in the others, but the stalk is very short and very thick, the terminal divisions are very broad and flat, and one of them is divided into two pieces.

I may say, therefore, that the sixth segment is like the others in plan, but that it is modified in its details.

The first segment is like the others, so far as its ring is concerned, and though its appendages differ from any of those yet examined in the simplicity of their structure, parts corresponding with the stem and one of the divisions of the appendages of the other segments can be readily discerned in them.

Thus it appears that the lobster's tail is composed of a series of segments which are fundamentally similar, though each presents peculiar modifications of the plan common to all. But when I turn to the forepart of the body I see, at first, nothing but a great shield-like shell, called technically the "carapace," ending in front in a sharp spine, on either side of which are the curious compound eyes, set upon the ends of stout movable stalks. Behind these, on the under side of the body, are two pairs of long feelers, or antennæ, [202] followed by six pairs of jaws folded against one another over the mouth, and five pairs of legs, the foremost of these being the great pinchers, or claws, of the lobster.

It looks, at first, a little hopeless to attempt to find in this complex mass a series of rings, each with its pair of appendages, such as I have shown you in the abdomen, and yet it is not difficult to demonstrate their existence. Strip off the legs, and you will find that each pair is attached to a very definite segment of the under wall of the body; but these segments, instead of being the lower parts of free rings, as in the tail, are such parts of rings which are all solidly united and bound together; and the like is true of the jaws, the feelers, and the eye-stalks, every pair of which is borne upon its own special segment. Thus the conclusion is gradually forced upon us, that the body of the lobster is composed of as many rings as there are pairs of appendages, namely, twenty in all, but that the six hindmost rings remain free and movable, while the fourteen front rings become firmly soldered together, their backs forming one continuous shield–the carapace.

Unity of plan, diversity in execution, is the lesson taught by the study of the rings of the body, and the same instruction is given still more emphatically by the appendages. If I examine the outermost jaw I find it consists of three distinct portions, an inner, a middle, and an outer, mounted [203] upon a common stem; and if I compare this jaw with the legs behind it, or the jaws in front of it, I find it quite easy to see, that, in the legs, it is the part of the appendage which corresponds with the inner division, which becomes modified into what we know familiarly as the "leg," while the middle division disappears, and the outer division is hidden under the carapace. Nor is it more difficult to discern that, in

the appendages of the tail, the middle division appears again and the outer vanishes; while, on the other hand, in the foremost jaw, the so-called mandible, the inner division only is left; and, in the same way, the parts of the feelers and of the eye-stalks can be identified with those of the legs and jaws.

But whither does all this tend? To the very remarkable conclusion that a unity of plan, of the same kind as that discoverable in the tail or abdomen of the lobster, pervades the whole organisation of its skeleton, so that I can return to the diagram representing any one of the rings of the tail, which I drew upon the board, and by adding a third division to each appendage, I can use it as a sort of scheme or plan of any ring of the body. I can give names to all the parts of that figure, and then if I take any segment of the body of the lobster, I can point out to you exactly, what modification the general plan has undergone in that particular segment; what part has remained movable, and what has become fixed to another; [204] what has been excessively developed and metamorphosed and what has been suppressed.

But I imagine I hear the question, How is all this to be tested? No doubt it is a pretty and ingenious way of looking at the structure of any animal; but is it anything more? Does Nature acknowledge, in any deeper way, this unity of plan we seem to trace?

The objection suggested by these questions is a very valid and important one, and morphology was in an unsound state so long as it rested upon the mere perception of the analogies which obtain between fully formed parts. The unchecked ingenuity of speculative anatomists proved itself fully competent to spin any number of contradictory hypotheses out of the same facts, and endless morphological dreams threatened to supplant scientific theory.

Happily, however, there is a criterion of morphological truth, and a sure test of all homologies. Our lobster has not always been what we see it; it was once an egg, a semifluid mass of yolk, not so big as a pin's head, contained in a transparent membrane, and exhibiting not the least trace of any one of those organs, the multiplicity and complexity of which, in the adult, are so surprising. After a time, a delicate patch of cellular membrane appeared upon one face of this yolk, and that patch was the foundation of the whole creature, the clay out of which it would be moulded. [205] Gradually investing the yolk, it became subdivided by transverse constrictions into segments, the forerunners of the rings of the body. Upon the ventral surface of each of the rings thus sketched out, a pair of bud-like prominences made their appearance–the rudiments of the appendages of the ring. At first, all the appendages were alike, but, as they grew, most of them became distinguished into a stem and two terminal divisions, to which in the middle part of the body, was added a third outer division; and it was only at a later period, that by the modification, or absorption, of certain of these primitive constituents, the limbs acquired their perfect form.

Thus the study of development proves that the doctrine of unity of plan is not merely a fancy, that it is not merely one way of looking at the matter, but that it is the expression of deep-seated natural facts. The legs and jaws of the lobster may not merely be regarded as modifications of a common type,–in fact and in nature they are so,–the leg and the jaw of the young animal being, at first, indistinguishable.

These are wonderful truths, the more so because the zoologist finds them to be of universal application. The investigation of a polype, of a snail, of a fish, of a horse, or of a man, would have led us, though by a less easy path, perhaps, to exactly the same point. Unity of plan everywhere lies hidden under the mask of diversity of structure–the [206] complex is everywhere evolved out of the simple. Every animal has at first the form of an egg, and every animal and every organic part, in reaching its adult state, passes through conditions common to other animals and other adult parts; and this leads me to another point. I have hitherto spoken as if the lobster were alone in the world, but, as I need hardly remind you, there are myriads of other animal organisms. Of these, some, such as men, horses, birds, fishes, snails, slugs, oysters, corals, and sponges, are not in the least like the lobster. But other animals, though they may differ a good deal from the lobster, are yet either very like it, or are like something that is like it. The cray fish, the rock lobster, and the prawn, and the shrimp, for example, however different, are yet so like lobsters, that a child would group them as of the lobster kind, in contradistinction to snails and slugs; and these last again would form a kind by themselves, in contradistinction to cows, horses, and sheep, the cattle kind.

But this spontaneous grouping into "kinds" is the first essay of the human mind at classification, or the calling by a common name of those things that are alike, and the arranging them in such a manner as best to suggest the sum of their likenesses and unlikenesses to other things.

Those kinds which include no other subdivisions than the sexes, or various breeds, are called, in technical language, species. The English lobster [207] is a species, our cray fish is another, our prawn is another. In other countries, however, there are lobsters, cray fish, and prawns, very like ours, and yet presenting sufficient differences to deserve distinction. Naturalists, therefore, express this resemblance and this diversity by grouping them as distinct species of the same "genus." But the lobster and the cray fish, though belonging to distinct genera, have many features in common, and hence are grouped together in an assemblage which is called a family. More distant resemblances connect the lobster with the prawn and the crab, which are expressed by putting all these into the same order. Again, more remote, but still very definite, resemblances unite the lobster with the woodlouse, the king crab, the water flea, and the barnacle, and separate them from all other animals; whence they collectively constitute the larger group, or class, *Crustacea.* But the *Crustacea* exhibit many peculiar features in common with insects, spiders, and centipedes, so that these are grouped into the still larger assemblage or "province" *Articulata;* and, finally, the relations which these have to worms and other lower animals, are expressed by combining the whole vast aggregate into the sub-kingdom of *Annulosa.*

If I had worked my way from a sponge instead of a lobster, I should have found it associated, by like ties, with a great number of other animals into the sub-kingdom *Protozoa;* if I had selected a fresh-water polype or a coral, the members of [208] what naturalists term the sub-kingdom *Cœlenterata*, would have grouped themselves around my type; had a snail been chosen, the inhabitants of all univalve and bivalve, land and water, shells, the lamp shells, the squids, and the sea-mat would have gradually linked themselves on to it as members of the same sub-kingdom of *Mollusca;* and finally, starting from man, I should have been compelled to admit first, the ape, the rat, the horse, the dog, into the same class; and then the bird, the crocodile, the turtle, the frog, and the fish, into the same sub-kingdom of *Vertebrata.*

And if I had followed out all these various lines of classification fully, I should discover in the end that there was no animal, either recent or fossil, which did not at once fall into one or other of these sub-kingdoms. In other words, every animal is organised upon one or other of the five, or more, plans, the existence of which renders our classification possible. And so definitely and precisely marked is the structure of each animal, that, in the present state of our knowledge, there is not the least evidence to prove that a form, in the slightest degree transitional between any of the two groups *Vertebrata, Annulosa, Mollusca,* and *Cœlenterata,* either exists, or has existed, during that period of the earth's history which is recorded by the geologist.[1] Nevertheless, you must not for a moment suppose, because no such [209] transitional forms are known, that the members of the sub-kingdoms are disconnected from, or independent of, one another. On the contrary, in their earliest condition they are all similar, and the primordial germs of a man, a dog, a bird, a fish, a beetle, a snail, and a polype are, in no essential structural respects, distinguishable.

In this broad sense, it may with truth be said, that all living animals, and all those dead faunæ which geology reveals, are bound together by an all-pervading unity of organisation, of the same character, though not equal in degree, to that which enables us to discern one and the same plan amidst the twenty different segments of a lobster's body. Truly it has been said, that to a clear eye the smallest fact is a window through which the Infinite may be seen.

Turning from these purely morphological considerations, let us now examine into the manner in which the attentive study of the lobster impels us into other lines of research.

Lobsters are found in all the European seas; but on the opposite shores of the Atlantic and in the seas of the southern hemisphere they do not exist. They are, however, represented in these regions by very closely allied, but distinct forms–the *Homarus Americanus* and the *Homarus Capensis:* so that we may say that the European has one species of *Homarus;* the American, another; the African another; and thus the [210] remarkable facts of geographical distribution begin to dawn upon us.

Again, if we examine the contents of the earth's crust, we shall find in the latter of those deposits, which have served as the great burying grounds of past ages, numberless lobster-like animals, but none so similar to our living lobster as to make zoologists sure that they belonged even to the same genus. If we go still further back in time, we discover, in the oldest rocks of all, the remains of animals, constructed on the same general plan as the lobster, and belonging to the same great group of *Crustacea;* but for the most part totally different from the lobster, and indeed from any other living form of crustacean; and thus we gain a notion of that successive change of the animal population of the globe, in past ages, which is the most striking fact revealed by geology.

Consider, now, where our inquiries have led us. We studied our type morphologically, when we determined its anatomy and its development, and when comparing it, in these respects, with other animals, we made out its place in a system of classification. If we were to examine every animal in a similar manner, we should establish a complete body of zoological morphology.

Again, we investigated the distribution of our type in space and in time, and, if the like had been done with every animal, the sciences of geo[211]graphical and geological distribution would have attained their limit.

But you will observe one remarkable circumstance, that, up to this point, the question of the life of these organisms has not come under consideration. Morphology and distribution might be studied almost as well, if animals and plants were a peculiar kind of crystals, and possessed none of those functions which distinguish living beings so remarkably. But the facts of morphology and distribution have to be accounted for, and the science, the aim of which it is to account for them, is Physiology.

Let us return to our lobster once more. If we watched the creature in its native element, we should see it climbing actively the submerged rocks, among which it delights to live, by means of its strong legs; or swimming by powerful strokes of its great tail, the appendages of the sixth joint of which are spread out into a broad fan-like propeller: seize it, and it will show you that its great claws are no mean weapons of offence; suspend a piece of carrion among its haunts, and it will greedily devour it, tearing and crushing the flesh by means of its multitudinous jaws.

Suppose that we had known nothing of the lobster but as an inert mass, an organic crystal, if I may use the phrase, and that we could suddenly see it exerting all these powers, what wonderful new ideas and new questions would arise in our [212] minds! The great new question would be, "How does all this take place?" the chief new idea would be, the idea of adaptation to purpose,–the notion, that the constituents of animal bodies are not mere unconnected parts, but organs working together to an end. Let us consider the tail of the lobster again from this point of view. Morphology has taught us that it is a series of segments composed of homologous parts, which undergo various modifications–beneath and through which a common plan of formation is discernible. But if I look at the same part physiologically, I see that it is a most beautifully constructed organ of locomotion, by means of which the animal can swiftly propel itself either backwards or forwards.

But how is this remarkable propulsive machine made to perform its functions? If I were suddenly to kill one of these animals and to take out all the soft parts, I should find the shell to be perfectly inert, to have no more power of moving itself than is possessed by the machinery of a mill when disconnected from its steam-engine or water-wheel. But if I were to open it, and take out the viscera only, leaving the white flesh, I should perceive that the lobster could bend and extend its tail as well as before. If I were to cut off the tail, I should cease to find any spontaneous motion in it; but on pinching any portion of the flesh, I should observe that it underwent a very curious [213] change–each fibre becoming shorter and thicker. By this act of contraction, as it is termed, the parts to which the ends of the fibre are attached are, of course, approximated; and according to the relations of their points of attachment to the centres of motions of the different rings, the bending or the extension of the tail results. Close observation of the newly-opened lobster would soon show that all its movements are due to the same cause–the shortening and thickening of these fleshy fibres, which are technically called muscles.

Here, then, is a capital fact. The movements of the lobster are due to muscular contractility. But why

does a muscle contract at one time and not at another? Why does one whole group of muscles contract when the lobster wishes to extend his tail, and another group when he desires to bend it? What is it originates, directs, and controls the motive power?

Experiment, the great instrument for the ascertainment of truth in physical science, answers this question for us. In the head of the lobster there lies a small mass of that peculiar tissue which is known as nervous substance. Cords of similar matter connect this brain of the lobster, directly or indirectly, with the muscles. Now, if these communicating cords are cut, the brain remaining entire, the power of exerting what we call voluntary motion in the parts below the sec[214]tion is destroyed; and, on the other hand, if, the cords remaining entire, the brain mass be destroyed, the same voluntary mobility is equally lost. Whence the inevitable conclusion is, that the power of originating these motions resides in the brain and is propagated along the nervous cords.

In the higher animals the phenomena which attend this transmission have been investigated, and the exertion of the peculiar energy which resides in the nerves has been found to be accompanied by a disturbance of the electrical state of their molecules.

If we could exactly estimate the signification of this disturbance; if we could obtain the value of a given exertion of nerve force by determining the quantity of electricity, or of heat, of which it is the equivalent; if we could ascertain upon what arrangement, or other condition of the molecules of matter, the manifestation of the nervous and muscular energies depends (and doubtless science will some day or other ascertain these points), physiologists would have attained their ultimate goal in this direction; they would have determined the relation of the motive force of animals to the other forms of force found in nature; and if the same process had been successfully performed for all the operations which are carried on in, and by, the animal frame, physiology would be perfect, and the facts of morphology [215] and distribution would be deducible from the laws which physiologists had established, combined with those determining the condition of the surrounding universe.

There is not a fragment of the organism of this humble animal whose study would not lead us into regions of thought as large as those which I have briefly opened up to you; but what I have been saying, I trust, has not only enabled you to form a conception of the scope and purport of zoology, but has given you an imperfect example of the manner in which, in my opinion, that science, or indeed any physical science, may be best taught. The great matter is, to make teaching real and practical, by fixing the attention of the student on particular facts; but at the same time it should be rendered broad and comprehensive, by constant reference to the generalisations of which all particular facts are illustrations. The lobster has served as a type of the whole animal kingdom, and its anatomy and physiology have illustrated for us some of the greatest truths of biology. The student who has once seen for himself the facts which I have described, has had their relations explained to him, and has clearly comprehended them, has, so far, a knowledge of zoology, which is real and genuine, however limited it may be, and which is worth more than all the mere reading knowledge of the science he could ever acquire. His zoologi[216]cal information is, so far, knowledge and not mere hearsay.

And if it were my business to fit you for the certificate in zoological science granted by this department, I should pursue a course precisely similar in principle to that which I have taken to-night. I should select a fresh-water sponge, a fresh-water polype or a *Cyanæa*, a fresh-water mussel, a lobster, a fowl, as types of the five primary divisions of the animal kingdom. I should explain their structure very fully, and show how each illustrated the great principles of zoology. Having gone very carefully and fully over this ground, I should feel that you had a safe foundation, and I should then take you in the same way, but less minutely, over similarly selected illustrative types of the classes; and then I should direct your attention to the special forms enumerated under the head of types, in this syllabus, and to the other facts there mentioned.

That would, speaking generally, be my plan. But I have undertaken to explain to you the best mode of acquiring and communicating a knowledge of zoology, and you may therefore fairly ask me for a more detailed and precise account of the manner in which I should propose to furnish you with the information I refer to.

My own impression is, that the best model for all kinds of training in physical science is that [217] afforded by the method of teaching anatomy, in use in the medical schools. This method consists of three elements–lectures, demonstrations, and examinations.

The object of lectures is, in the first place, to awaken the attention and excite the enthusiasm of the student; and this, I am sure, may be effected to a far greater extent by the oral discourse and by the personal influence of a respected teacher than in any other way. Secondly, lectures have the double use of guiding the student to the salient points of a subject, and at the same time forcing him to attend to the whole of it, and not merely to that part which takes his fancy. And lastly, lectures afford the student the opportunity of seeking explanations of those difficulties which will, and indeed ought to, arise in the course of his studies.

What books shall I read? is a question constantly put by the student to the teacher. My reply usually is, "None: write your notes out carefully and fully; strive to understand them thoroughly; come to me for the explanation of anything you cannot understand; and I would rather you did not distract your mind by reading." A properly composed course of lectures ought to contain fully as much matter as a student can assimilate in the time occupied by its delivery; and the teacher should always recollect that his business is to feed, and not to cram the intellect. [218] Indeed, I believe that a student who gains from a course of lectures the simple habit of concentrating his attention upon a definitely limited series of facts, until they are thoroughly mastered, has made a step of immeasurable importance.

But, however good lectures may be, and however extensive the course of reading by which they are followed up, they are but accessories to the great instrument of scientific teaching–demonstration. If I insist unweariedly, nay fanatically, upon the importance of physical science as an educational agent, it is because the study of any branch of science, if properly conducted, appears to me to fill up a void left by all other means of education. I have the greatest respect and love for literature; nothing would grieve me more than to see literary training other than a very prominent branch of education: indeed, I wish that

real literary discipline were far more attended to than it is; but I cannot shut my eyes to the fact, that there is a vast difference between men who have had a purely literary, and those who have had a sound scientific training.

Seeking for the cause of this difference, I imagine I can find it in the fact that, in the world of letters, learning and knowledge are one, and books are the source of both; whereas in science, as in life, learning and knowledge are [219] distinct, and the study of things, and not of books, is the source of the latter.

All that literature has to bestow may be obtained by reading and by practical exercise in writing and in speaking; but I do not exaggerate when I say, that none of the best gifts of science are to be won by these means. On the contrary, the great benefit which a scientific education bestows, whether as training or as knowledge, is dependent upon the extent to which the mind of the student is brought into immediate contact with facts–upon the degree to which he learns the habit of appealing directly to Nature, and of acquiring through his senses concrete images of those properties of things, which are, and always will be, but approximatively expressed in human language. Our way of looking at Nature, and of speaking about her, varies from year to year; but a fact once seen, a relation of cause and effect, once demonstratively apprehended, are possessions which neither change nor pass away, but, on the contrary, form fixed centres, about which other truths aggregate by natural affinity.

Therefore, the great business of the scientific teacher is, to imprint the fundamental, irrefragable facts of his science, not only by words upon the mind, but by sensible impressions upon the eye, and ear, and touch of the student, in so complete a manner, that every term used, or law enunciated, should afterwards call up vivid images of the [220] particular structural, or other, facts which furnished the demonstration of the law, or the illustration of the term.

Now this important operation can only be achieved by constant demonstration, which may take place to a certain imperfect extent during a lecture, but which ought also to be carried on independently, and which should be addressed to each individual student, the teacher endeavouring, not so much to show a thing to the learner, as to make him see it for himself.

I am well aware that there are great practical difficulties in the way of effectual zoological demonstrations. The dissection of animals is not altogether pleasant, and requires much time; nor is it easy to secure an adequate supply of the needful specimens. The botanist has here a great advantage; his specimens are easily obtained, are clean and wholesome, and can be dissected in a private house as well as anywhere else; and hence, I believe, the fact, that botany is so much more readily and better taught than its sister science. But, be it difficult or be it easy, if zoological science is to be properly studied, demonstration, and, consequently, dissection, must be had. Without it, no man can have a really sound knowledge of animal organisation.

A good deal may be done, however, without actual dissection on the student's part, by demonstration upon specimens and preparations; and in [221] all probability it would not be very difficult, were the demand sufficient, to organise collections of such objects, sufficient for all the purposes of elementary

teaching, at a comparatively cheap rate. Even without these, much might be effected, if the zoological collections, which are open to the public, were arranged according to what has been termed the "typical principle"; that is to say, if the specimens exposed to public view were so selected that the public could learn something from them, instead of being, as at present, merely confused by their multiplicity. For example, the grand ornithological gallery at the British Museum contains between two and three thousand species of birds, and sometimes five or six specimens of a species. They are very pretty to look at, and some of the cases are, indeed, splendid; but I will undertake to say, that no man but a professed ornithologist has ever gathered much information from the collection. Certainly, no one of the tens of thousands of the general public who have walked through that gallery ever knew more about the essential peculiarities of birds when he left the gallery than when he entered it. But if, somewhere in that vast hall, there were a few preparations, exemplifying the leading structural peculiarities and the mode of development of a common fowl; if the types of the genera, the leading modifications in the skeleton, in the plumage at various [222] ages, in the mode of nidification, and the like, among birds, were displayed; and if the other specimens were put away in a place where the men of science, to whom they are alone useful, could have free access to them, I can conceive that this collection might become a great instrument of scientific education.

The last implement of the teacher to which I have adverted is examination–a means of education now so thoroughly understood that I need hardly enlarge upon it. I hold that both written and oral examinations are indispensable, and, by requiring the description of specimens, they may be made to supplement demonstration.

Such is the fullest reply the time at my disposal will allow me to give to the question–how may a knowledge of zoology be best acquired and communicated?

But there is a previous question which may be moved, and which, in fact, I know many are inclined to move. It is the question, why should teachers be encouraged to acquire a knowledge of this, or any other branch of physical science? What is the use, it is said, of attempting to make physical science a branch of primary education? Is it not probable that teachers, in pursuing such studies, will be led astray from the acquirement of more important but less attractive knowledge? And, even if they can learn something of science without prejudice to their useful[223]ness, what is the good of their attempting to instil that knowledge into boys whose real business is the acquisition of reading, writing, and arithmetic?

These questions are, and will be, very commonly asked, for they arise from that profound ignorance of the value and true position of physical science, which infests the minds of the most highly educated and intelligent classes of the community. But if I did not feel well assured that they are capable of being easily and satisfactorily answered; that they have been answered over and over again; and that the time will come when men of liberal education will blush to raise such questions–I should be ashamed of my position here to-night. Without doubt, it is your great and very important function to carry out elementary education; without question, anything that should interfere with the faithful fulfilment of that duty on your part would be a great evil; and if I thought that your acquirement of the elements of physical science, and your communication of those elements to your pupils, involved any sort of interference with your proper duties, I should be the first person to protest against your being

encouraged to do anything of the kind.

But is it true that the acquisition of such a knowledge of science as is proposed, and the communication of that knowledge, are calculated to weaken your usefulness? Or may I not rather [224] ask, is it possible for you to discharge your functions properly without these aids?

What is the purpose of primary intellectual education? I apprehend that its first object is to train the young in the use of those tools wherewith men extract knowledge from the ever-shifting succession of phenomena which pass before their eyes; and that its second object is to inform them of the fundamental laws which have been found by experience to govern the course of things, so that they may not be turned out into the world naked, defenceless, and a prey to the events they might control.

A boy is taught to read his own and other languages, in order that he may have access to infinitely wider stores of knowledge than could ever be opened to him by oral intercourse with his fellow men; he learns to write, that his means of communication with the rest of mankind may be indefinitely enlarged, and that he may record and store up the knowledge he acquires. He is taught elementary mathematics, that he may understand all those relations of number and form, upon which the transactions of men, associated in complicated societies, are built, and that he may have some practice in deductive reasoning.

All these operations of reading, writing, and ciphering, are intellectual tools, whose use should, before all things, be learned, and learned thoroughly; so that the youth may be enabled to [225] make his life that which it ought to be, a continual progress in learning and in wisdom.

But, in addition, primary education endeavours to fit a boy out with a certain equipment of positive knowledge. He is taught the great laws of morality; the religion of his sect; so much history and geography as will tell him where the great countries of the world are, what they are, and how they have become what they are.

Without doubt all these are most fitting and excellent things to teach a boy; I should be very sorry to omit any of them from any scheme of primary intellectual education. The system is excellent, so far as it goes.

But if I regard it closely, a curious reflection arises. I suppose that, fifteen hundred years ago, the child of any well-to-do Roman citizen was taught just these same things; reading and writing in his own, and, perhaps, the Greek tongue; the elements of mathematics; and the religion, morality, history, and geography current in his time. Furthermore, I do not think I err in affirming, that, if such a Christian Roman boy, who had finished his education, could be transplanted into one of our public schools, and pass through its course of instruction, he would not meet with a single unfamiliar line of thought; amidst all the new facts he would have to learn, not one would suggest a different mode of regarding the universe from that current in his own time.

[226] And yet surely there is some great difference between the civilisation of the fourth century and

that of the nineteenth, and still more between the intellectual habits and tone of thought of that day and this?

And what has made this difference? I answer fearlessly–The prodigious development of physical science within the last two centuries.

Modern civilisation rests upon physical science; take away her gifts to our own country, and our position among the leading nations of the world is gone to-morrow; for it is physical science only that makes intelligence and moral energy stronger than brute force.

The whole of modern thought is steeped in science; it has made its way into the works of our best poets, and even the mere man of letters, who affects to ignore and despise science, is unconsciously impregnated with her spirit, and indebted for his best products to her methods. I believe that the greatest intellectual revolution mankind has yet seen is now slowly taking place by her agency. She is teaching the world that the ultimate court of appeal is observation and experiment, and not authority; she is teaching it to estimate the value of evidence; she is creating a firm and living faith in the existence of immutable moral and physical laws, perfect obedience to which is the highest possible aim of an intelligent being.

[227] But of all this your old stereotyped system of education takes no note. Physical science, its methods, its problems, and its difficulties, will meet the poorest boy at every turn, and yet we educate him in such a manner that he shall enter the world as ignorant of the existence of the methods and facts of science as the day he was born. The modern world is full of artillery; and we turn out our children to do battle in it, equipped with the shield and sword of an ancient gladiator.

Posterity will cry shame on us if we do not remedy this deplorable state of things. Nay, if we live twenty years longer, our own consciences will cry shame on us.

It is my firm conviction that the only way to remedy it is to make the elements of physical science an integral part of primary education. I have endeavoured to show you how that may be done for that branch of science which it is my business to pursue; and I can but add, that I should look upon the day when every schoolmaster throughout this land was a centre of genuine, however rudimentary, scientific knowledge, as an epoch in the history of the country.

But let me entreat you to remember my last words. Addressing myself to you, as teachers, I would say, mere book learning in physical science is a sham and a delusion–what you teach, unless you wish to be impostors, that you must first [228] know; and real knowledge in science means personal acquaintance with the facts, be they few or many.[2]

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[1] [The different grouping necessitated by later knowledge does not affect the principle of the argument.–1894.]

[2] It has been suggested to me that these words may be taken to imply a discouragement on my part of any sort of scientific instruction which does not give an acquaintance with the facts at first hand. But this is not my meaning. The ideal of scientific teaching is, no doubt, a system by which the scholar sees every fact for himself, and the teacher supplies only the explanations. Circumstances, however, do not often allow of the attainment of that ideal, and we must put up with the next best system–one in which the scholar takes a good deal on trust from a teacher, who, knowing the facts by his own knowledge, can describe them with so much vividness as to enable his audience to form competent ideas concerning them. The system which I repudiate is that which allows teachers who have not come into direct contact with the leading facts of a science to pass their second-hand information on. The scientific virus, like vaccine lymph, if passed through too long a succession of organisms, will lose all its effect in protecting the young against the intellectual epidemics to which they are exposed.

[The remarks on p. 222 applied to the Natural History Collection of the British Museum in 1861. The visitor to the Natural History Museum in 1894 need go no further than the Great Hall to see the realisation of my hopes by the present Director.]

THE HUXLEY FILE

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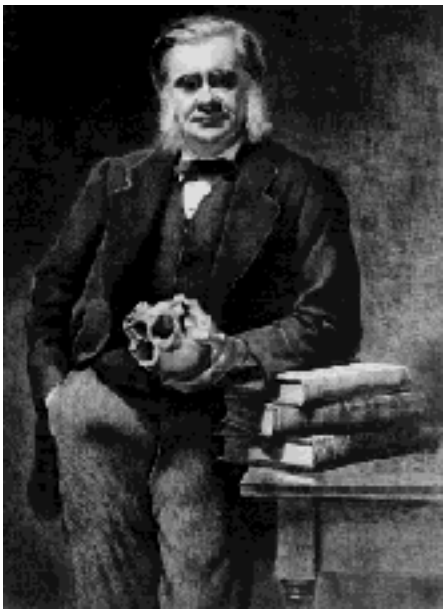

President of the B.A.A.S.

The Period 1870

Biogenesis and Abiogenesis

Critiques and Addresses (1870)

Collected Essays VIII

[229] It has long been the custom for the newly installed President of the British Association for the

Advancement of Science to take advantage of the elevation of the position in which the suffrages of his colleagues had, for the time, placed him, and, casting his eyes around the horizon of the scientific world, to report to them what could be seen from his watch-tower; in what directions the multitudinous divisions of the noble army of the improvers of natural knowledge were marching; what important strongholds of the great enemy of us all, ignorance, had been recently captured; and, also, with due impartiality, to mark where the advanced posts of science had been driven in, or a long-continued siege had made no progress.

[230] I propose to endeavour to follow this ancient precedent, in a manner suited to the limitations of my knowledge and of my capacity. I shall not presume to attempt a panoramic survey of the world of science, nor even to give a sketch of what is doing in the one great province of biology, with some portions of which my ordinary occupations render me familiar. But I shall endeavour to put before you the history of the rise and progress of a single biological doctrine; and I shall try to give some notion of the fruits, both intellectual and practical, which we owe, directly or indirectly, to the working out, by seven generations of patient and laborious investigators, of the thought which arose, more than two centuries ago, in the mind of a sagacious and observant Italian naturalist.

It is a matter of everyday experience that it is difficult to prevent many articles of food from becoming covered with mould; that fruit, sound enough to all appearance, often contains grubs at the core; that meat, left to itself in the air, is apt to putrefy and swarm with maggots. Even ordinary water, if allowed to stand in an open vessel, sooner or later becomes turbid and full of living matter.

The philosophers of antiquity, interrogated as to the cause of these phenomena, were provided with a ready and a plausible answer. It did not enter their minds even to doubt that these low forms of [231] life were generated in the matters in which they made their appearance. Lucretius, who had drunk deeper of the scientific spirit than any poet of ancient or modern times except Goethe, intends to speak as a philosopher, rather than as a poet, when he writes that "with good reason the earth has gotten the name of mother, since all things are produced out of the earth. And many living creatures, even now, spring out of the earth, taking form by the rains and the heat of the sun."[1] The axiom of ancient science, "that the corruption of one thing is the birth of another," had its popular embodiment in the notion that a seed dies before the young plant springs from it; a belief so widespread and so fixed, that Saint Paul appeals to it in one of the most splendid outbursts of his fervid eloquence:–

"Thou fool, that which thou sowest is not quickened, except it die."[2]

The proposition that life may, and does, proceed from that which has no life, then, was held alike by the philosophers, the poets, and the people, of [232] the most enlightened nations, eighteen hundred years ago; and it remained the accepted doctrine of learned and unlearned Europe, through the Middle Ages, down even to the seventeenth century.

It is commonly counted among the many merits of our great countryman, Harvey, that he was the first to declare the opposition of fact to venerable authority in this, as in other matters; but I can discover no

justification for this widespread notion. After careful search through the "Exercitationes de Generatione," the most that appears clear to me is, that Harvey believed all animals and plants to spring from what he terms a "*primordium vegetale,*" a phrase which may nowadays be rendered "a vegetative germ"; and this, he says, is "*oviforme,"* or "egg-like"; not, he is careful to add, that it necessarily has the shape of an egg, but because it has the constitution and nature of one. That this "*primordium oviforme*" must needs, in all cases, proceed from a living parent is nowhere expressly maintained by Harvey, though such an opinion may be thought to be implied in one or two passages; while, on the other hand, he does, more than once, use language which is consistent only with a full belief in spontaneous or equivocal generation.[3] In fact, the main concern of Harvey's [233] wonderful little treatise is not with generation, in the physiological sense, at all, but with development; and his great object is the establishment of the doctrine of epigenesis.

The first distinct enunciation of the hypothesis that all living matter has sprung from pre-existing living matter, came from a contemporary, though a junior, of Harvey, a native of that country, fertile in men great in all departments of human activity, which was to intellectual Europe, in the sixteenth and seventeenth centuries, what Germany is in the nineteenth. It was in Italy, and from Italian teachers, that Harvey received the most important part of his scientific education. And it was a student trained in the same schools, Francesco Redi–a man of the widest knowledge and most versatile abilities, distinguished alike as scholar, poet, physician, and naturalist–who, just two hundred and two years ago, published his "Esperienze intorno alla Generazione degl' Insetti," and gave to the world the idea, the growth of which it is my purpose to trace. Redi's book went through five editions in twenty years; and the extreme [234] simplicity of his experiments, and the clearness of his arguments, gained for his views, and for their consequences, almost universal acceptance.

Redi did not trouble himself much with speculative considerations, but attacked particular cases of what was supposed to be "spontaneous generation" experimentally. Here are dead animals, or pieces of meat, says he; I expose them to the air in hot weather, and in a few days they swarm with maggots. You tell me that these are generated in the dead flesh; but if I put similar bodies, while quite fresh, into a jar, and tie some fine gauze over the top of the jar, not a maggot makes its appearance, while the dead substances, nevertheless, putrefy just in the same way as before. It is obvious, therefore, that the maggots are not generated by the corruption of the meat; and that the cause of their formation must be a something which is kept away by gauze. But gauze will not keep away aëriform bodies, or fluids. This something must, therefore, exist in the form of solid particles too big to get through the gauze. Nor is one long left in doubt what these solid particles are; for the blowflies, attracted by the odour of the meat, swarm round the vessel, and, urged by a powerful but in this case misleading instinct, lay eggs out of which maggots are immediately hatched, upon the gauze. The conclusion, therefore, is un[235] avoidable; the maggots are not generated by the meat, but the eggs which give rise to them are brought through the air by the flies.

These experiments seem almost childishly simple, and one wonders how it was that no one ever thought of them before. Simple as they are, however, they are worthy of the most careful study, for every piece of experimental work since done, in regard to this subject, has been shaped upon the model furnished by

the Italian philosopher. As the results of his experiments were the same, however varied the nature of the materials he used, it is not wonderful that there arose in Redi's mind a presumption, that, in all such cases of the seeming production of life from dead matter, the real explanation was the introduction of living germs from without into that dead matter.[4] [236] And thus the hypothesis that living matter always arises by the agency of pre-existing living matter, took definite shape; and had, henceforward, a right to be considered and a claim to be refuted, in each particular case, before the production of living matter in any other way could be admitted by careful reasoners. It will be necessary for me to refer to this hypothesis so frequently, that, to save circumlocution, I shall call it the hypothesis of *Biogenesis;* and I shall term the contrary doctrine–that living matter may be produced by not living matter–the hypothesis of *Abiogenesis.*

In the seventeenth century, as I have said, the latter was the dominant view, sanctioned alike by antiquity and by authority; and it is interesting to observe that Redi did not escape the customary tax upon a discoverer of having to defend himself against the charge of impugning the authority of the Scriptures;[5] for his adversaries declared that [237] the generation of bees from the carcase of a dead lion is affirmed, in the Book of Judges, to have been the origin of the famous riddle with which Samson perplexed the Philistines:–

> "Out of the eater came forth meat,
> And out of the strong came forth sweetness."

Against all odds, however, Redi, strong with the strength of demonstrable fact, did splendid battle for Biogenesis; but it is remarkable that he held the doctrine in a sense which, if he had lived in these times, would have infallibly caused him to be classed among the defenders of "spontaneous generation." "Omne vivum ex vivo," "no life without antecedent life," aphoristically sums up Redi's doctrine; but he went no further. It is most remarkable evidence of the philosophic caution and impartiality of his mind, that although he had speculatively anticipated the manner in which grubs really are deposited in fruits and in the galls of plants, he deliberately admits that the evidence is insufficient to bear him out; and he therefore prefers the supposition that they are generated by a modification of the living substance of the plants themselves. Indeed, he regards these vegetable growths as organs, by means of which the plant gives rise to an animal, and looks upon this production of specific animals as the final cause of the galls and of, at any rate, some fruits. And he proposes to explain the occurrence [238] of parasites within the animal body in the same way.[6]

[239] It is of great importance to apprehend Redi's position rightly; for the lines of thought he laid down for us are those upon which naturalists have been working ever since. Clearly, he held *Biogenesis* as against *Abiogenesis;* and I shall immediately proceed, in the first place, to inquire how far subsequent investigation has borne him out in so doing.

But Redi also thought that there were two modes of Biogenesis. By the one method, which is that of common and ordinary occurrence, the living parent gives rise to offspring which passes through the same cycle of changes as itself–like gives rise to like; and this has been termed *Homogenesis.* By the

other mode, the living parent was supposed to give rise to offspring which passed through a totally different series of states from those exhibited by the parent, and did not return into the cycle of the parent; this is what ought to be called *Heterogenesis*, the offspring being altogether, and permanently, unlike the parent. The term Heterogenesis, however, has unfortunately been used in a different sense, and M. Milne-Edwards has therefore substituted for it *Xenogenesis*, which means the generation of something foreign. After discussing Redi's hypothesis of universal Biogenesis, then, I shall go [240] on to ask how far the growth of science justifies his other hypothesis of Xenogenesis.

The progress of the hypothesis of Biogenesis was triumphant and unchecked for nearly a century. The application of the microscope to anatomy in the hands of Grew, Leeuwenhoek, Swammerdam, Lyonnet, Vallisnieri, Réaumur, and other illustrious investigators of nature of that day, displayed such a complexity of organisation in the lowest and minutest forms, and everywhere revealed such a prodigality of provision for their multiplication by germs of one sort or another, that the hypothesis of Abiogenesis began to appear not only untrue, but absurd; and, in the middle of the eighteenth century, when Needham and Buffon took up the question, it was almost universally discredited.[7]

But the skill of the microscope makers of the eighteenth century soon reached its limit. A microscope magnifying 400 diameters was a *chef d'œuvre* of the opticians of that day; and, at the same time, by no means trustworthy. But a magnifying power of 400 diameters, even when [241] definition reaches the exquisite perfection of our modern achromatic lenses, hardly suffices for the mere discernment of the smallest forms of life. A speck, only 1/25th of an inch in diameter, has, at ten inches from the eye, the same apparent size as an object 1/10000th of an inch in diameter, when magnified 400 times; but forms of living matter abound, the diameter of which is not more than 1/40000th of an inch. A filtered infusion of hay, allowed to stand for two days, will swarm with living things among which, any which reaches the diameter of a human red blood-corpuscle, or about 1/3200th of an inch, is a giant. It is only by bearing these facts in mind, that we can deal fairly with the remarkable statements and speculations put forward by Buffon and Needham in the middle of the eighteenth century.

When a portion of any animal or vegetable body is infused in water, it gradually softens and disintegrates; and, as it does so, the water is found to swarm with minute active creatures, the so-called Infusorial Animalcules, none of which can be seen, except by the aid of the microscope; while a large proportion belong to the category of smallest things of which I have spoken, and which must have looked like mere dots and lines under the ordinary microscopes of the eighteenth century.

Led by various theoretical considerations which [242] I cannot now discuss, but which looked promising enough in the lights of their time, Buffon and Needham doubted the applicability of Redi's hypothesis to the infusorial animalcules, and Needham very properly endeavoured to put the question to an experimental test. He said to himself, If these infusorial animalcules come from germs, their germs must exist either in the substance infused, or in the water with which the infusion is made, or in the superjacent air. Now the vitality of all germs is destroyed by heat. Therefore, if I boil the infusion, cork it up carefully, cementing the cork over with mastic, and then heat the whole vessel by heaping hot ashes over it, I must needs kill whatever germs are present. Consequently, if Redi's hypothesis hold good,

when the infusion is taken away and allowed to cool, no animalcules ought to be developed in it; whereas, if the animalcules are not dependent on pre-existing germs, but are generated from the infused substance, they ought, by and by, to make their appearance. Needham found that, under the circumstances in which he made his experiments, animalcules always did arise in the infusions, when a sufficient time had elapsed to allow for their development.

In much of his work Needham was associated with Buffon, and the results of their experiments fitted in admirably with the great French naturalist's hypothesis of "organic molecules," according [243] to which, life is the indefeasible property of certain indestructible molecules of matter, which exist in all living things, and have inherent activities by which they are distinguished from not living matter. Each individual living organism is formed by their temporary combination. They stand to it in the relation of the particles of water to a cascade, or a whirlpool; or to a mould, into which the water is poured. The form of the organism is thus determined by the reaction between external conditions and the inherent activities of the organic molecules of which it is composed; and, as the stoppage of a whirlpool destroys nothing but a form, and leaves the molecules of the water, with all their inherent activities intact, so what we call the death and putrefaction of an animal, or of a plant, is merely the breaking up of the form, or manner of association, of its constituent organic molecules, which are then set free as infusorial animalcules.

It will be perceived that this doctrine is by no means identical with *Abiogenesis*, with which it is often confounded. On this hypothesis, a piece of beef, or a handful of hay, is dead only in a limited sense. The beef is dead ox, and the hay is dead grass; but the "organic molecules" of the beef or the hay are not dead, but are ready to manifest their vitality as soon as the bovine or herbaceous shrouds in which they are imprisoned are rent by the macerating action of water. The hypothesis [244] therefore must be classified under Xenogenesis, rather than under Abiogenesis. Such as it was, I think it will appear, to those who will be just enough to remember that it was propounded before the birth of modern chemistry, and of the modern optical arts, to be a most ingenious and suggestive speculation.

But the great tragedy of Science–the slaying of a beautiful hypothesis by an ugly fact–which is so constantly being enacted under the eyes of philosophers, was played, almost immediately, for the benefit of Buffon and Needham.

Once more, an Italian, the Abbé Spallanzani, a worthy successor and representative of Redi in his acuteness, his ingenuity, and his learning, subjected the experiments and the conclusions of Needham to a searching criticism. It might be true that Needham's experiments yielded results such as he had described, but did they bear out his arguments? Was it not possible, in the first place, he had not completely excluded the air by his corks and mastic? And was it not possible, in the second place, that he had not sufficiently heated his infusions and the superjacent air? Spallanzani joined issue with the English naturalist on both these pleas, and he showed that if, in the first place, the glass vessels in which the infusions were contained were hermetically sealed by fusing their necks, and if, in the second place, they were exposed to the temperature of boiling water for [245] three-quarters of an hour,[8] no animalcules ever made their appearance within them. It must be admitted that the experiments and

arguments of Spallanzani furnish a complete and a crushing reply to those of Needham. But we all too often forget that it is one thing to refute a proposition, and another to prove the truth of a doctrine which, implicitly or explicitly, contradicts that proposition; and the advance of science soon showed that though Needham might be quite wrong, it did not follow that Spallanzani was quite right.

Modern Chemistry, the birth of the latter half of the eighteenth century, grew apace, and soon found herself face to face with the great problems which biology had vainly tried to attack without her help. The discovery of oxygen led to the laying of the foundations of a scientific theory of respiration, and to an examination of the marvellous interactions of organic substances with oxygen. The presence of free oxygen appeared to be one of the conditions of the existence of life, and of those singular changes in organic matters which are known as fermentation and putrefaction. The question of the generation of the infusory animalcules thus passed into a new phase. For what might not have happened to the organic matter of the infusions, or to the oxygen of the air, in Spallanzani's experiments? What security was there that the development of life which ought [246] to have taken place had not been checked or prevented by these changes?

The battle had to be fought again. It was needful to repeat the experiments under conditions which would make sure that neither the oxygen of the air, nor the composition of the organic matter, was altered in such a manner as to interfere with the existence of life.

Schulze and Schwann took up the question from this point of view in 1836 and 1837. The passage of air through red-hot glass tubes, or through strong sulphuric acid, does not alter the proportion of its oxygen, while it must needs arrest, or destroy, any organic matter which may be contained in the air. These experimenters, therefore, contrived arrangements by which the only air which should come into contact with a boiled infusion should be such as had either passed through red-hot tubes or through strong sulphuric acid. The result which they obtained was that an infusion so treated developed no living things, while, if the same infusion was afterwards exposed to the air, such things appeared rapidly and abundantly. The accuracy of these experiments has been alternately denied and affirmed. Supposing them to be accepted, however, all that they really proved was that the treatment to which the air was subjected destroyed *something* that was essential to the development of life in the infusion. This "something" might be gaseous, fluid, or solid; [247] that it consisted of germs remained only an hypothesis of greater or less probability.

Contemporaneously with these investigations a remarkable discovery was made by Cagniard de la Tour. He found that common yeast is composed of a vast accumulation of minute plants. The fermentation of must, or of wort, in the fabrication of wine and of beer, is always accompanied by the rapid growth and multiplication of these *Torulæ*. Thus, fermentation, in so far as it was accompanied by the development of microscopical organisms in enormous numbers, became assimilated to the decomposition of an infusion of ordinary animal or vegetable matter; and it was an obvious suggestion that the organisms were, in some way or other, the causes both of fermentation and of putrefaction. The chemists, with Berzelius and Liebig at their head, at first laughed this idea to scorn; but in 1843, a man then very young, who has since performed the unexampled feat of attaining to high eminence alike in Mathematics, Physics, and Physiology–I speak of the illustrious Helmholtz–reduced the matter to the

test of experiment by a method alike elegant and conclusive. Helmholtz separated a putrefying or a fermenting liquid from one which was simply putrescible or fermentable by a membrane which allowed the fluids to pass through and become intermixed, but stopped the passage of solids. The result was, that while the putrescible or the fermentable liquids became impregnated with the results of the putrescence or fermentation which was going on on the other side of the membrane, they neither putrefied (in the ordinary way) nor fermented; nor were any of the organisms which abounded in the fermenting or putrefying liquid generated in them. Therefore the cause of the development of these organisms must lie in something which cannot pass through membranes; and as Helmholtz's investigations were long antecedent to Graham's researches upon colloids, his natural conclusion was that the agent thus intercepted must be a solid material. In point of fact, Helmholtz's experiments narrowed the issue to this: that which excites fermentation and putrefaction, and at the same time gives rise to living forms in a fermentable or putrescible fluid, is not a gas and is not a diffusible fluid; therefore it is either a colloid, or it is matter divided into very minute solid particles.

The researches of Schroeder and Dusch in 1854, and of Schroeder alone, in 1859, cleared up this point by experiments which are simply refinements upon those of Redi. A lump of cotton-wool is, physically speaking, a pile of many thicknesses of a very fine gauze, the fineness of the meshes of which depends upon the closeness of the compression of the wool. Now, Schroeder and Dusch found, that, in the case of all the putrefiable materials which they used (except milk and yolk [249] of egg), an infusion boiled, and then allowed to come into contact with no air but such as had been filtered through cotton-wool, neither putrefied, nor fermented, nor developed living forms. It is hard to imagine what the fine sieve formed by the cotton-wool could have stopped except minute solid particles. Still the evidence was incomplete until it had been positively shown, first, that ordinary air does contain such particles; and, secondly, that filtration through cotton-wool arrests these particles and allows only physically pure air to pass. This demonstration has been furnished within the last year by the remarkable experiments of Professor Tyndall. It has been a common objection of Abiogenists that, if the doctrine of Biogeny is true, the air must be thick with germs; and they regard this as the height of absurdity. But nature occasionally is exceedingly unreasonable, and Professor Tyndall has proved that this particular absurdity may nevertheless be a reality. He has demonstrated that ordinary air is no better than a sort of stirabout of excessively minute solid particles; that these particles are almost wholly destructible by heat; and that they are strained off, and the air rendered optically pure, by its being passed through cotton-wool.

It remains yet in the order of logic, though not of history, to show that among these solid destructible particles, there really do exist germs capable of giving rise to the development of living [250] forms in suitable menstrua. This piece of work was done by M. Pasteur in those beautiful researches which will ever render his name famous; and which, in spite of all attacks upon them, appear to me now, as they did seven years ago,[9] to be models of accurate experimentation and logical reasoning. He strained air through cotton-wool, and found, as Schroeder and Dusch had done, that it contained nothing competent to give rise to the development of life in fluids highly fitted for that purpose. But the important further links in the chain of evidence added by Pasteur are three. In the first place he subjected to microscopic examination the cotton-wool which had served as strainer, and found that sundry bodies clearly recognisable as germs, were among the solid particles strained off. Secondly, he proved that these germs

were competent to give rise to living forms by simply sowing them in a solution fitted for their development. And, thirdly, he showed that the incapacity of air strained through cottonwool to give rise to life, was not due to any occult change effected in the constituents of the air by the wool, by proving that the cotton-wool might be dispensed with altogether, and perfectly free access left between the exterior air and that in the experimental flask. If the neck of the flask is drawn out into a tube and bent downwards; and [251] if, after the contained fluid has been carefully boiled, the tube is heated sufficiently to destroy any germs which may be present in the air which enters as the fluid cools, the apparatus may be left to itself for any time and no life will appear in the fluid. The reason is plain. Although there is free communication between the atmosphere laden with germs and the germless air in the flask, contact between the two takes place only in the tube; and as the germs cannot fall upwards, and there are no currents, they never reach the interior of the flask. But if the tube be broken short off where it proceeds from the flask, and free access be thus given to germs falling vertically out of the air, the fluid, which has remained clear and desert for months, becomes, in a few days, turbid and full of life.

These experiments have been repeated over and over again by independent observers with entire success; and there is one very simple mode of seeing the facts for one's self, which I may as well describe.

Prepare a solution (much used by M. Pasteur, and often called "Pasteur's solution") composed of water with tartrate of ammonia, sugar, and yeast-ash dissolved therein.[10] Divide it into three portions in as many flasks; boil all three for a [252] quarter of an hour; and, while the steam is passing out, stop the neck of one with a large plug of cotton-wool, so that this also may be thoroughly steamed. Now set the flasks aside to cool, and, when their contents are cold, add to one of the open ones a drop of filtered infusion of hay which has stood for twenty-four hours, and is consequently full of the active and excessively minute organisms known as *Bacteria.* In a couple of days of ordinary warm weather the contents of this flask will be milky from the enormous multiplication of *Bacteria.* The other flask, open and exposed to the air, will, sooner or later, become milky with *Bacteria,* and patches of mould may appear in it; while the liquid in the flask, the neck of which is plugged with cotton-wool, will remain clear for an indefinite time. I have sought in vain for any explanation of these facts, except the obvious one, that the air contains germs competent to give rise to *Bacteria,* such as those with which the first solution has been knowingly and purposely inoculated, and to the mould-*Fungi.* And I have not yet been able to meet with any advocate of Abiogenesis who seriously maintains that the atoms of sugar, tartrate of ammonia, yeast-ash, and water, under no influence but that of free access of air and the ordinary temperature, re-arrange themselves and give rise to the protoplasm of *Bacterium.* But the alternative is to admit that these *Bacteria* arise from germs in the air; and if they are thus propagated, [253] the burden of proof that other like forms are generated in a different manner, must rest with the assertor of that proposition.

To sum up the effect of this long chain of evidence:–

It is demonstrable that a fluid eminently fit for the development of the lowest forms of life, but which contains neither germs, nor any protein compound, gives rise to living things in great abundance if it is

exposed to ordinary air; while no such development takes place, if the air with which it is in contact is mechanically freed from the solid particles which ordinarily float in it, and which may be made visible by appropriate means.

It is demonstrable that the great majority of these particles are destructible by heat, and that some of them are germs, or living particles, capable of giving rise to the same forms of life as those which appear when the fluid is exposed to unpurified air.

It is demonstrable that inoculation of the experimental fluid with a drop of liquid known to contain living particles gives rise to the same phenomena as exposure to unpurified air.

And it is further certain that these living particles are so minute that the assumption of their suspension in ordinary air presents not the slightest difficulty. On the contrary, considering their lightness and the wide diffusion of the organisms which produce them, it is impossible to [254] conceive that they should not be suspended in the atmosphere in myriads.

Thus the evidence, direct and indirect, in favour of *Biogenesis* for all known forms of life must, I think, be admitted to be of great weight.

On the other side, the sole assertions worthy of attention are that hermetically sealed fluids, which have been exposed to great and long-continued heat, have sometimes exhibited living forms of low organisation when they have been opened.

The first reply that suggests itself is the probability that there must be some error about these experiments, because they are performed on an enormous scale every day with quite contrary results. Meat, fruits, vegetables, the very materials of the most fermentable and putrescible infusions, are preserved to the extent, I suppose I may say, of thousands of tons every year, by a method which is a mere application of Spallanzani's experiment. The matters to be preserved are well boiled in a tin case provided with a small hole, and this hole is soldered up when all the air in the case has been replaced by steam. By this method they may be kept for years without putrefying, fermenting, or getting mouldy. Now this is not because oxygen is excluded, inasmuch as it is now proved that free oxygen is not necessary for either fermentation or putrefaction. It is not because the tins are exhausted of air, for [255] *Vibriones* and *Bacteria* live, as Pasteur has shown, without air or free oxygen. It is not because the boiled meats or vegetables are not putrescible or fermentable, as those who have had the misfortune to be in a ship supplied with unskilfully closed tins well know. What is it, therefore, but the exclusion of germs? I think that Abiogenists are bound to answer this question before they ask us to consider new experiments of precisely the same order.

And in the next place, if the results of the experiments I refer to are really trustworthy, it by no means follows that Abiogenesis has taken place. The resistance of living matter to heat is known to vary within considerable limits, and to depend, to some extent, upon the chemical and physical qualities of the surrounding medium. But if, in the present state of science, the alternative is offered us,–either germs

can stand a greater heat than has been supposed, or the molecules of dead matter, for no valid or intelligible reason that is assigned, are able to re-arrange themselves into living bodies, exactly such as can be demonstrated to be frequently produced in another way,–I cannot understand how choice can be, even for a moment, doubtful.

But though I cannot express this conviction of mine too strongly, I must carefully guard myself against the supposition that I intend to suggest that no such thing as Abiogenesis ever has taken [256] place in the past, or ever will take place in the future. With organic chemistry, molecular physics, and physiology yet in their infancy, and every day making prodigious strides, I think it would be the height of presumption for any man to say that the conditions under which matter assumes the properties we call "vital" may not, some day, be artificially brought together. All I feel justified in affirming is, that I see no reason for believing that the feat has been performed yet.

And looking back through the prodigious vista of the past, I find no record of the commencement of life, and therefore I am devoid of any means of forming a definite conclusion as to the conditions of its appearance. Belief, in the scientific sense of the word, is a serious matter, and needs strong foundations. To say, therefore, in the admitted absence of evidence, that I have any belief as to the mode in which the existing forms of life have originated, would be using words in a wrong sense. But expectation is permissible where belief is not; and if it were given me to look beyond the abyss of geologically recorded time to the still more remote period when the earth was passing through physical and chemical conditions, which it can no more see again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from not living matter. I should expect to see it appear under [257] forms of great simplicity, endowed, like existing fungi, with the power of determining the formation of new protoplasm from such matters as ammonium carbonates, oxalates and tartrates, alkaline and earthy phosphates, and water, without the aid of light. That is the expectation to which analogical reasoning leads me; but I beg you once more to recollect that I have no right to call my opinion anything but an act of philosophical faith.

So much for the history of the progress of Redi's great doctrine of Biogenesis, which appears to me, with the limitations I have expressed, to be victorious along the whole line at the present day.

As regards the second problem offered to us by Redi, whether Xenogenesis obtains, side by side with Homogenesis,–whether, that is, there exist not only the ordinary living things, giving rise to offspring which run through the same cycle as themselves, but also others, producing offspring which are of a totally different character from themselves,–the researches of two centuries have led to a different result. That the grubs found in galls are no product of the plants on which the galls grow, but are the result of the introduction of the eggs of insects into the substance of these plants, was made out by Vallisnieri, Réaumur, and others, before the end of the first half of the eighteenth century. The tapeworms, [258] bladderworms, and flukes continued to be a stronghold of the advocates of Xenogenesis for a much longer period. Indeed, it is only within the last thirty years that the splendid patience of Von Siebold, Van Beneden, Leuckart, Küchenmeister, and other helminthologists, has succeeded in tracing every such parasite, often through the strangest wanderings and metamorphoses, to an egg derived from a parent, actually or potentially like itself; and the tendency of inquiries elsewhere has all been in the same

direction. A plant may throw off bulbs, but these, sooner or later, give rise to seeds or spores, which develop into the original form. A polype may give rise to Medusæ, or a pluteus to an Echinoderm, but the Medusa and the Echinoderm give rise to eggs which produce polypes or plutei, and they are therefore only stages in the cycle of life of the species.

But if we turn to pathology, it offers us some remarkable approximations to true Xenogenesis.

As I have already mentioned, it has been known since the time of Vallisnieri and of Réaumur, that galls in plants, and tumours in cattle, are caused by insects, which lay their eggs in those parts of the animal or vegetable frame of which these morbid structures are outgrowths. Again, it is a matter of familiar experience to everybody that mere pressure on the skin will give rise to a corn. Now the gall, the tumour, [259] and the corn are parts of the living body, which have become, to a certain degree, independent and distinct organisms. Under the influence of certain external conditions, elements of the body, which should have developed in due subordination to its general plan, set up for themselves and apply the nourishment which they receive to their own purposes.

From such innocent productions as corns and warts, there are all gradations to the serious tumours which, by their mere size and the mechanical obstruction they cause, destroy the organism out of which they are developed; while, finally, in those terrible structures known as cancers, the abnormal growth has acquired powers of reproduction and multiplication, and is only morphologically distinguishable from the parasitic worm, the life of which is neither more nor less closely bound up with that of the infested organism.

If there were a kind of diseased structure, the histological elements of which were capable of maintaining a separate and independent existence out of the body, it seems to me that the shadowy boundary between morbid growth and Xenogenesis would be effaced. And I am inclined to think that the progress of discovery has almost brought us to this point already. I have been favoured by Mr. Simon with an early copy of the last published of the valuable "Reports on the [260] Public Health," which, in his capacity of their medical officer, he annually presents to the Lords of the Privy Council. The appendix to this report contains an introductory essay "On the Intimate Pathology of Contagion," by Dr. Burdon- Sanderson, which is one of the clearest, most comprehensive, and well-reasoned discussions of a great question which has come under my notice for a long time. I refer you to it for details and for the authorities for the statements I am about to make.

You are familiar with what happens in vaccination. A minute cut is made in the skin, and an infinitesimal quantity of vaccine matter is inserted into the wound. Within a certain time a vesicle appears in the place of the wound, and the fluid which distends this vesicle is vaccine matter, in quantity a hundred or a thousandfold that which was originally inserted. Now what has taken place in the course of this operation? Has the vaccine matter, by its irritative property, produced a mere blister, the fluid of which has the same irritative property? Or does the vaccine matter contain living particles, which have grown and multiplied where they have been planted? The observations of M. Chauveau, extended and confirmed by Dr. Sanderson himself, appear to leave no doubt upon this head. Experiments, similar in

principle to those of Helmholtz on fermentation and putrefaction, have proved that the active [261] element in the vaccine lymph is non-diffusible, and consists of minute particles not exceeding 1/20000th of an inch in diameter, which are made visible in the lymph by the microscope. Similar experiments have proved that two of the most destructive of epizootic diseases, sheep-pox and glanders, are also dependent for their existence and their propagation upon extremely small living solid particles, to which the title of *microzymes* is applied. An animal suffering under either of these terrible diseases is a source of infection and contagion to others, for precisely the same reason as a tub of fermenting beer is capable of propagating its fermentation by "infection," or "contagion," to fresh wort. In both cases it is the solid living particles which are efficient; the liquid in which they float, and at the expense of which they live, being altogether passive.

Now arises the question, are these microzymes the results of *Homogenesis,* or of *Xenogenesis*? are they capable, like the *Torulæ* of yeast, of arising only by the development of pre-existing germs? or may they be, like the constituents of a nut-gall, the results of a modification and individualisation of the tissues of the body in which they are found, resulting from the operation of certain conditions? Are they parasites in the zoological sense, or are they merely what Virchow has called "heterologous growths"? It is obvious that this question has the most profound importance, [262] whether we look at it from a practical or from a theoretical point of view. A parasite may be stamped out by destroying its germs, but a pathological product can only be annihilated by removing the conditions which give rise to it.

It appears to me that this great problem will have to be solved for each zymotic disease separately, for analogy cuts two ways. I have dwelt upon the analogy of pathological modification, which is in favour of the xenogenetic origin of microzymes; but I must now speak of the equally strong analogies in favour of the origin of such pestiferous particles by the ordinary process of the generation of like from like.

It is, at present, a well-established fact that certain diseases, both of plants and of animals, which have all the characters of contagious and infectious epidemics, are caused by minute organisms. The smut of wheat is a well-known instance of such a disease, and it cannot be doubted that the grape-disease and the potato-disease fall under the same category. Among animals, insects are wonderfully liable to the ravages of contagious and infectious diseases caused by microscopic *Fungi.*

In autumn, it is not uncommon to see flies motionless upon a window-pane, with a sort of magic circle, in white, drawn round them. On microscopic examination, the magic circle is found to consist of innumerable spores, which have been [263] thrown off in all directions by a minute fungus called *Empusa muscæ,* the spore-forming filaments of which stand out like a pile of velvet from the body of the fly. These spore-forming filaments are connected with others which fill the interior of the fly's body like so much fine wool, having eaten away and destroyed the creature's viscera. This is the full-grown condition of the *Empusa.* If traced back to its earliest stages, in flies which are still active, and to all appearance healthy, it is found to exist in the form of minute corpuscles which float in the blood of the fly. These multiply and lengthen into filaments, at the expense of the fly's substance; and when they have at last killed the patient, they grow out of its body and give off spores. Healthy flies shut up with diseased ones catch this mortal disease, and perish like the others. A most competent observer, M. Cohn, who studied the development of the *Empusa* very carefully, was utterly unable to discover in what

manner the smallest germs of the *Empusa* got into the fly. The spores could not be made to give rise to such germs by cultivation; nor were such germs discoverable in the air, or in the food of the fly. It looked exceedingly like a case of Abiogenesis, or, at any rate, of Xenogenesis; and it is only quite recently that the real course of events has been made out. It has been ascertained, that when one of the spores falls upon the body of a fly, it begins to germinate, and sends out a process which bores its way through the fly's skin; this, having reached the interior cavities of its body, gives off the minute floating corpuscles which are the earliest stage of the *Empusa.* The disease is "contagious," because a healthy fly coming in contact with a diseased one, from which the spore-bearing filaments protrude, is pretty sure to carry off a spore or two. It is "infectious" because the spores become scattered about all sorts of matter in the neighbourhood of the slain flies.

The silkworm has long been known to be subject to a very fatal and infectious disease called the *Muscardine.* Audouin transmitted it by inoculation. This disease is entirely due to the development of a fungus, *Botrytis Bassiana,* in the body of the caterpillar; and its contagiousness and infectiousness are accounted for in the same way as those of the fly-disease. But, of late years, a still more serious epizootic has appeared among the silkworms; and I may mention a few facts which will give you some conception of the gravity of the injury which it has inflicted on France alone.

The production of silk has been for centuries an important branch of industry in Southern France, and in the year 1853 it had attained such a magnitude that the annual produce of the French sericulture was estimated to amount to a [265] tenth of that of the whole world, and represented a money-value of 117,000,000 francs, or nearly five millions sterling. What may be the sum which would represent the money-value of all the industries connected with the working up of the raw silk thus produced, is more than I can pretend to estimate. Suffice it to say, that the city of Lyons is built upon French silk as much as Manchester was upon American cotton before the civil war.

Silkworms are liable to many diseases; and, even before 1853, a peculiar epizootic, frequently accompanied by the appearance of dark spots upon the skin (whence the name of "Pébrine" which it has received), had been noted for its mortality. But in the years following 1853 this malady broke out with such extreme violence, that, in 1858, the silk-crop was reduced to a third of the amount which it had reached in 1853; and, up till within the last year or two, it has never attained half the yield of 1853. This means not only that the great number of people engaged in silk growing are some thirty millions sterling poorer than they might have been; it means not only that high prices have had to be paid for imported silkworm eggs, and that, after investing his money in them, in paying for mulberry-leaves and for attendance, the cultivator has constantly seen his silkworms perish and himself plunged in ruin; but it means that the looms of [266] Lyons have lacked employment, and that, for years, enforced idleness and misery have been the portion of a vast population which, in former days, was industrious and well-to-do.

In 1858 the gravity of the situation caused the French Academy of Sciences to appoint Commissioners, of whom a distinguished naturalist, M. de Quatrefages, was one, to inquire into the nature of this disease, and, if possible, to devise some means of staying the plague. In reading the Report[11] made by M. de Quatrefages in 1859, it is exceedingly interesting to observe that his elaborate study of the Pébrine

forced the conviction upon his mind that, in its mode of occurrence and propagation, the disease of the silkworm is, in every respect, comparable to the cholera among mankind. But it differs from the cholera, and so far is a more formidable malady, in being hereditary, and in being, under some circumstances, contagious as well as infectious.

The Italian naturalist, Filippi, discovered in the blood of the silkworms affected by this strange disorder a multitude of cylindrical corpuscles, each about 1/6000th of an inch long. These have been carefully studied by Lebert, and named by him *Panhistophyton;* for the reason that in subjects in which the disease is strongly developed, the corpuscles swarm in every tissue and organ of the body, and even pass into the undeveloped eggs of [267] the female moth. But are these corpuscles causes, or mere concomitants, of the disease? Some naturalists took one view and some another; and it was not until the French Government, alarmed by the continued ravages of the malady, and the inefficiency of the remedies which had been suggested, despatched M. Pasteur to study it, that the question received its final settlement; at a great sacrifice, not only of the time and peace of mind of that eminent philosopher, but, I regret to have to add, of his health.

But the sacrifice has not been in vain. It is now certain that this devastating, cholera-like, Pébrine, is the effect of the growth and multiplication of the *Panhistophyton* in the silkworm. It is contagious and infectious, because the corpuscles of the *Panhistophyton* pass away from the bodies of the diseased caterpillars, directly or indirectly, to the alimentary canal of healthy silkworms in their neighbourhood; it is hereditary because the corpuscles enter into the eggs while they are being formed, and consequently are carried within them when they are laid; and for this reason, also, it presents the very singular peculiarity of being inherited only on the mother's side. There is not a single one of all the apparently capricious and unaccountable phenomena presented by the Pébrine, but has received its explanation from the fact that the disease is the result of the presence of the microscopic organism, *Panhistophyton.*

[268] Such being the facts with respect to the Pébrine, what are the indications as to the method of preventing it? It is obvious that this depends upon the way in which the *Panhistophyton* is generated. If it may be generated by Abiogenesis, or by Xenogenesis, within the silkworm or its moth, the extirpation of the disease must depend upon the prevention of the occurrence of the conditions under which this generation takes place. But if, on the other hand, the *Panhistophyton* is an independent organism, which is no more generated by the silkworm than the mistletoe is generated by the apple-tree or the oak on which it grows, though it may need the silkworm for its development in the same way as the mistletoe needs the tree, then the indications are totally different. The sole thing to be done is to get rid of and keep away the germs of the *Panhistophyton.* As might be imagined, from the course of his previous investigations, M. Pasteur was led to believe that the latter was the right theory; and, guided by that theory, he has devised a method of extirpating the disease, which has proved to be completely successful wherever it has been properly carried out.

There can be no reason, then, for doubting that, among insects, contagious and infectious diseases, of great malignity, are caused by minute organisms which are produced from pre-existing germs, or by homogenesis; and there is no reason, that I know of, for believing that what happens in insects may [269] not take place in the highest animals. Indeed, there is already strong evidence that some diseases

of an extremely malignant and fatal character to which man is subject, are as much the work of minute organisms as is the Pébrine. I refer for this evidence to the very striking facts adduced by Professor Lister in his various well-known publications on the antiseptic method of treatment. It appears to me impossible to rise from the perusal of those publications without a strong conviction that the lamentable mortality which so frequently dogs the footsteps of the most skilful operator, and those deadly consequences of wounds and injuries which seem to haunt the very walls of great hospitals, and are, even now, destroying more men than die of bullet or bayonet, are due to the importation of minute organisms into wounds, and their increase and multiplication; and that the surgeon who saves most lives will be he who best works out the practical consequences of the hypothesis of Redi.

I commenced this Address by asking you to follow me in an attempt to trace the path which has been followed by a scientific idea, in its long and slow progress from the position of a probable hypothesis to that of an established law of nature. Our survey has not taken us into very attractive regions; it has lain, chiefly, in a land flowing with the abominable, and peopled with mere grubs and mouldiness. And it may be imagined with what [270] smiles and shrugs, practical and serious contemporaries of Redi and of Spallanzani may have commented on the waste of their high abilities in toiling at the solution of problems which, though curious enough in themselves, could be of no conceivable utility to mankind.

Nevertheless, you will have observed that before we had travelled very far upon our road, there appeared, on the right hand and on the left, fields laden with a harvest of golden grain, immediately convertible into those things which the most solidly practical men will admit to have value–viz., money and life.

The direct loss to France caused by the Pébrine in seventeen years cannot be estimated at less than fifty millions sterling; and if we add to this what Redi's idea, in Pasteur's hands, has done for the wine-grower and for the vinegar-maker, and try to capitalise its value, we shall find that it will go a long way towards repairing the money losses caused by the frightful and calamitous war of this autumn. And as to the equivalent of Redi's thought in life, how can we over-estimate the value of that knowledge of the nature of epidemic and epizootic diseases, and consequently of the means of checking, or eradicating them, the dawn of which has assuredly commenced?

Looking back no further than ten years, it is possible to select three (1863, 1864, and 1869) in [271] which the total number of deaths from scarlet-fever alone amounted to ninety thousand. That is the return of killed, the maimed and disabled being left out of sight. Why, it is to be hoped that the list of killed in the present bloodiest of all wars will not amount to more than this! But the facts which I have placed before you must leave the least sanguine without a doubt that the nature and the causes of this scourge will, one day, be as well understood as those of the Pébrine are now; and that the long-suffered massacre of our innocents will come to an end.

And thus mankind will have one more admonition that "the people perish for lack of knowledge"; and that the alleviation of the miseries, and the promotion of the welfare, of men must be sought, by those who will not lose their pains, in that diligent, patient, loving study of all the multitudinous aspects of

Nature, the results of which constitute exact knowledge, or Science. It is the justification and the glory of this great meeting that it is gathered together for no other object than the advancement of the moiety of science which deals with those phenomena of nature which we call physical. May its endeavours be crowned with a full measure of success!

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[1] It is thus that Mr. Munro renders

> "Linquitur, ut merito maternum nomen adepta
> Terra sit, e terra quoniam sunt cuncta creata.
> Multaque nunc etiam exsistant animalia terris
> Imbribus et calido solis concreta vapore."

De Rerum Natura, lib. v. 793–796.

But would not the meaning of the last line be better rendered "Developed in rain-water and in the warm vapours raised by the sun"?

[2] 1 Corinthians xv. 36.

[3] See the following passage in Exercitatio I.:–Item *sponte nascentia* dicuntur; non quod ex *putredine* oriunda sint, sed quod casu, naturæ sponte, et æquivocâ (ut aiunt) generatione, a parentibus sui dissimilibus proveniant." Again, in *De Uteri Membranis*–In cunctorum viventium generatione (sicut diximus) hoc solenne est, ut ortum ducunt a *primordio* aliquo, quod tum materiam tum efficiendi potestatem in se habet: sitque adeo id, ex quo et a quo quicquid nascitur, ortum suum ducat. Tale primordium in animalibus (*sive ab aliis generantibus proveniant, sive sponte, aut ex putredine nascentur*) est humor in tunicâ aliquâaut putami ne conclusus." Compare also what Redi has to say respecting Harvey's opinion, *Esperienze,* p. 11.

[4] "Pure contentandomi sempre in questa ed in ciasuna altro cosa, da ciascuno piú savio, la dove io difettuosamente parlassi, esser corretto; non tacero, che per molte osservazioni molti volti da me fatte, mi sento inclinato a credere che la terra, da quelle prime piante, e da quei primi animali in poi, che ella nei primi giorni del mondo produsse per comandemento del sovrano ed omnipotente Fattore, non abbia mai più prodotto da se medesima nè erba nè albero, nè animale alcuno perfetto o imperfetto che ei se fosse; e che tutto quello, che ne' tempi trapassati è nato e che ora nascere in lei, o da lei veggiamo, venga tutto dalla semenza reale e vera delle piante, e degli animali stessi, i quali col mezzo del proprio seme la loro spezie conservano. E se bene tutto giorno scorghiamo da' cadaveri degli animali, e da tutte quante le maniere dell' erbe, e de' fiori, e dei frutti imputriditi, e corrotti nascere vermi infiniti–

> 'Nonne vides quæcunque mora, fluidoque calore
> Corpora tabescunt in parva animalia verti'–

Io mi sento, dico, inclinato, a credere che tutti quei vermi si generino dal seme paterno; e che le carni, e 1' erbe, e 1' altre cose tutte putrefatte, o putrefattibili non facciano altra parte, nè abbiano altro ufizio nella generazione

degl' insetti, se non d'apprestare un luogo o un nido proporzionato, in cui dagli animali nel tempo della figliatura sieno portati, e partoriti i vermi, o 1' uova o 1' altre semenze dei vermi, i quali tosto che nati sono, trovano in esso nido un sufficiente alimento abilissimo per nutricarsi: e se in quello non son portate dalle madri queste suddette semenze, niente mai, e replicatamente niente, vi s' ingegneri e nasca."–Redi, *Esperienze*, pp. 14-16.

[5] "Molti, e molti altri ancora vi potrei annoverare, se non fossi chiamato a rispondere alle rampogne di alcuni, che bruscamente mi rammentano ciò, che si legge nel capitolo quattordicesimo del sacrosanto Libro de' giudici...."–Redi, *loc. cit.* p. 45.

[6] The passage (*Experienze*, p. 129) is worth quoting in full:–

"Se dovessi palesarvi il mio sentimento crederei che i frutti, i legumi gli alberi e le foglie, in due maniere inverminassero. Una, perchè venendo i bachi per di fuora, e cercando 1' alimento, col rodere ci aprono la strada, ed arrivano alla più interna midolla de' frutti e de' legni. L'altra maniera si è, che io per me stimerei, che non fosse gran fatto disdicevole il credere, che quell' anima o quella virtù, la quale genera i fiori ed i frutti nelle piante viventi, sia quella stessa che generi ancora i bachi di esse piante. E chi sà forse, che molti frutti degli alberi non sieno prodotti, non per un fine primario e principale, ma bensi per un uffizio secondario e servile, destinato alla generazione di que' vermi, servendo a loro in vece di matrice, in cui dimorino un prefisso e determinato tempo; il quale arrivato escan fuora a godere il sole.

"Io m' immagino, che questo mio pensiero non vi parrà totalmente un paradosso; mentre farete riflessione a quelle tante sorte di galle, di gallozzole, di coccole, di ricci, di calici, di cornetti ed i lappole, che son produtte dalle quercel, dalle farnie, da' cerri, da' sugheri, da' lecci e da altri simili alberi de ghianda; imperciocchè in quelle gallozzole, e particolarmente nelle più grosse, che si chiamano coronati, ne' ricci capelluti, che ciuffoli da' nostri contadini son detti; nei ricci legnosi del cerro, ne' ricci stellati della quercia, nelle galluzze della foglia del leccio si vede evidentissimamente, che la prima e principale intenzione della natura è formare dentro di quelle un animale volante; vedendosi nel centro della gallozzola un uovo, che col crescere e col maturarsi di essa gallozzola va crescendo e maturando anch' egli, e cresce altresi a suo tempo quel verme, che nell' uovo si racchiude; il qual verme, quando la gallozzola è finita di maturare e che è venuto il termine destinato al suo nascimento diventa, di verme che era, una mosca.... Io vi confesso ingenuamente, che prima d'aver fatte queste mie esperienze intorno alla generazione degl' insetti mi dava a credere, o per dir meglio sospettava, che forse la gallozzola nascesse, perchè arrivando la mosca nel tempo della primavera, e facendo una piccolissima fessura ne' rami più teneri daile quercia, in quella fessura nascondesse uno de suoi semi, il quale fosse cagione che sbocciasse fuora la gallozzola; e che mai non si vedessero galle o gallozzole o ricci o cornetti o calici o coccole, se non in que' rami, ne' quali le mosche avessero depositate le loro semenze; e mi dava ad intendere, che le gallozzole fossero una malattia cagionata nelle querce della punture delle mosche, in quelle giusa stessa che dalle puntur d' altri animaletti simiglievoli veggiamo crescere de' tumori ne' corpi degli animali."

[7] Needham, writing in 1750, says:–

"Les naturalistes modernes s'accordent unaninement à établir, comme une vérité certaine, que toute plante vient de sa sémence spécifique, tout animal d'un œuf ou de quelque chose d'analogue préexistant dans la plante, ou dans l'animal de même espèce qui l'a produit."–*Nouvelles Observations*, p. 169.

"Les naturalistes ont généralemente cru que les animaux microscopiques étaient engendrés par des œufs

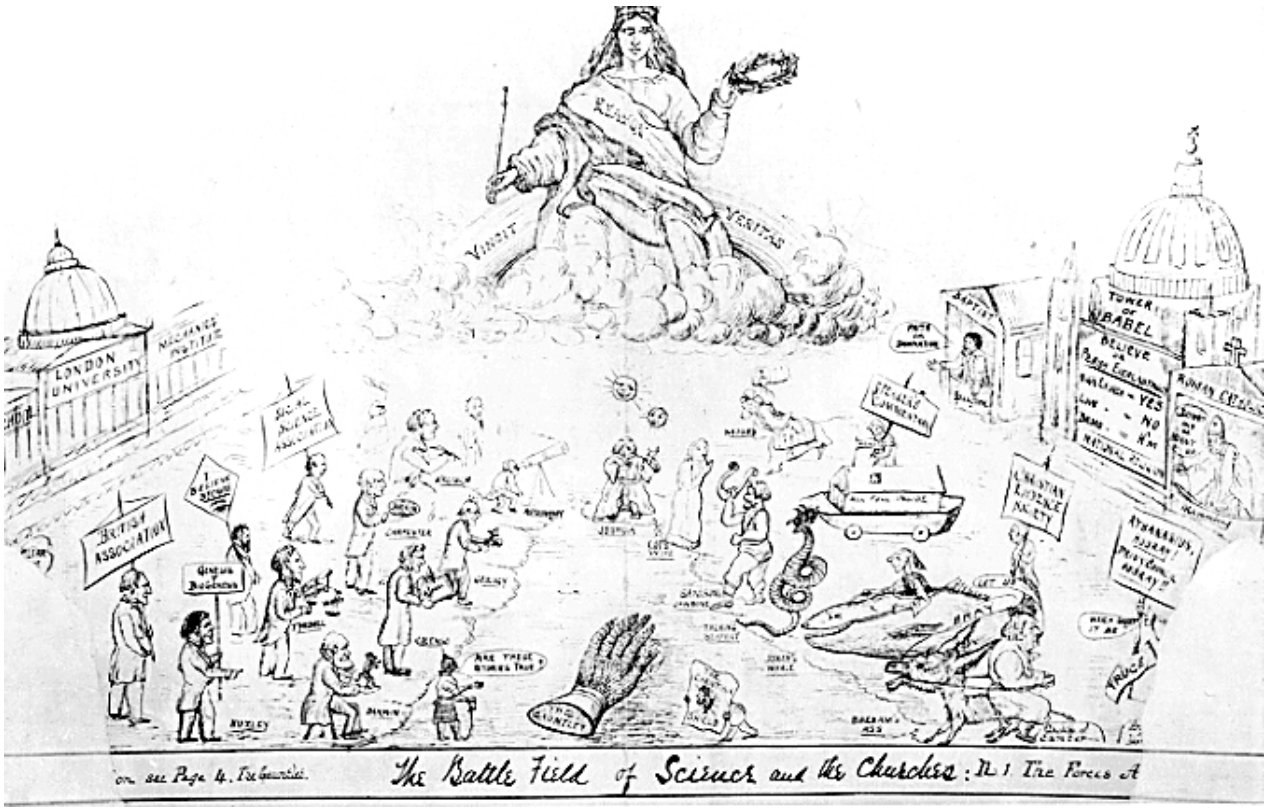
transportés dans l'air, ou déposés dans des eaux dormantes par des insectes volans."–*Ibid.* p. 176.

[8] See Spallanzani, *Opera*e vi. pp. 42 and 51.

[9] *Lectures to Working Men on the Causes of the Phenomena of Organic Nature*, 1863. (See Vol. II of these Essays.)

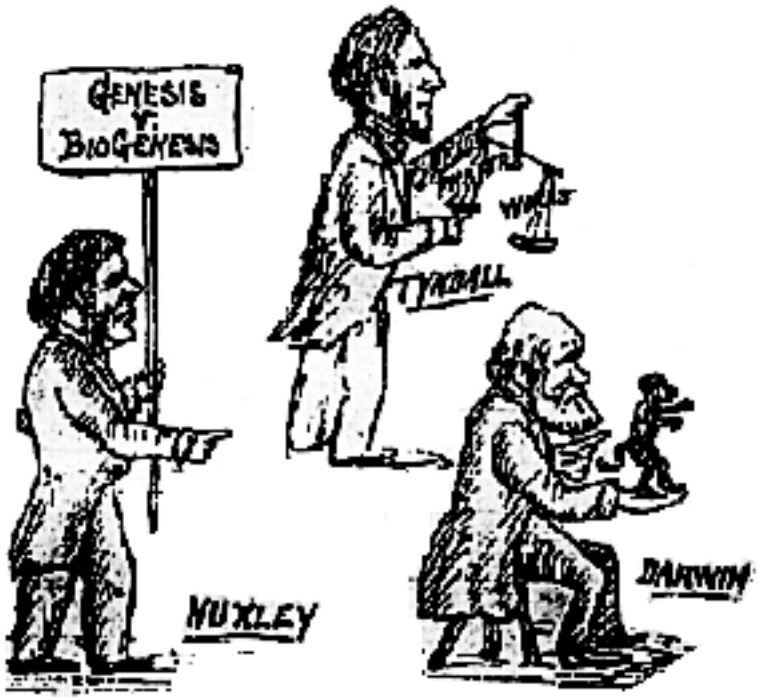
[10] Infusion of hay treated in the same way yields similar results; but as it contains organic matter, the argument which follows cannot be based upon it.

[11] *Etudes sur les Maladies actuelles des Vers à Soie*, p. 53.



"The Battlefield of Science and the Churches"

The Gauntlet 1870



Close-up

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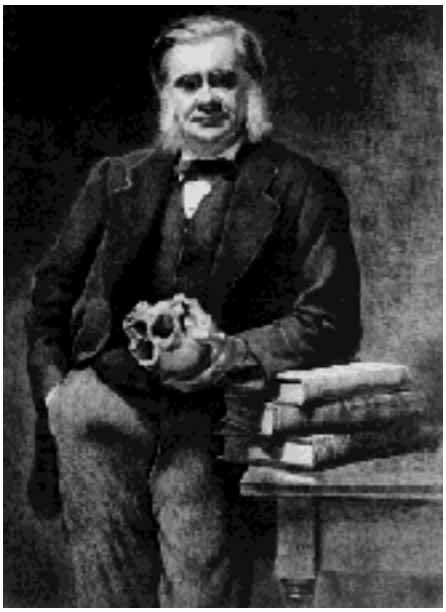

Preface and Table of Contents to Volume VII, *Discourses: Biological & Geological,* of Huxley's *Collected Essays.*

Next article: Geological Contemporaneity and Persistent Types of Life [1862], pages 272-304.

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C. Blinderman & D. Joyce
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Geological Reform

Lay Sermons (1869)

Collected Essays VIII

[305] "A great reform in geological speculation seems now to have become necessary."

"It is quite certain that a great mistake has been made–that British popular geology at the present time is in direct opposition to the principles of Natural Philosophy."[1]

In reviewing the course of geological thought during the past year, for the purpose of discovering those matters to which I might most fitly direct your attention in the Address which it now becomes my duty to deliver from the Presidential Chair, the two somewhat alarming sentences which I have just read, and which occur in an able and interesting essay by an eminent natural philosopher, rose into such prominence before my mind that they eclipsed everything else.

It surely is a matter of paramount importance [306] for the British geologists (some of them very popular geologists too) here in solemn annual session assembled, to inquire whether the severe judgment thus passed upon them by so high an authority as Sir William Thomson is one to which they must plead guilty *sans phrase,* or whether they are prepared to say "not guilty," and appeal for a reversal of the sentence to that higher court of educated scientific opinion to which we are all amenable.

As your attorney-general for the time being, I thought I could not do better than get up the case with a view of advising you. It is true that the charges brought forward by the other side involve the consideration of matters quite foreign to the pursuits with which I am ordinarily occupied; but, in that respect, I am only in the position which is, nine times out of ten, occupied by counsel, who nevertheless contrive to gain their causes, mainly by force of mother-wit and common-sense, aided by some training in other intellectual exercises.

Nerved by such precedents, I proceed to put my pleading before you.

And the first question with which I propose to deal is, What is it to which Sir W. Thomson refers when he speaks of "geological speculation" and "British popular geology"?

I find three, more or less contradictory, systems of geological thought, each of which might fairly [307] enough claim these appellations, standing side by side in Britain. I shall call one of them Catastrophism, another Uniformitarianism, the third Evolutionism; and I shall try briefly to sketch the characters of each, that you may say whether the classification is, or is not, exhaustive.

By Catastrophism, I mean any form of geological speculation which, in order to account for the phenomena of geology, supposes the operation of forces different in their nature, or immeasurably different in power, from those which we at present see in action in the universe.

The Mosaic cosmogony is, in this sense, catastrophic, because it assumes the operation of extra-natural power. The doctrine of violent upheavals, *débâcles,* and cataclysms in general is catastrophic, so far as it assumes that these were brought about by causes which have now no parallel. There was a time when catastrophism might, pre-eminently, have claimed the title of "British popular geology"; and assuredly it has yet many adherents, and reckons among its supporters some of the most honoured members of this Society.

By Uniformitarianism, I mean especially, the teaching of Hutton and of Lyell.

That great though incomplete work, "The Theory of the Earth," seems to me to be one of the most remarkable contributions to geology which is recorded in the annals of the science. [308] So far as the not-living world is concerned, uniformitarianism lies there, not only in germ, but in blossom and fruit.

If one asks how it is that Hutton was led to entertain views so far in advance of those prevalent in his time, in some respects; while, in others, they seem almost curiously limited, the answer appears to me to be plain.

Hutton was in advance of the geological speculation of his time, because, in the first place, he had amassed a vast store of knowledge of the facts of geology, gathered by personal observation in travels of considerable extent; and because, in the second place, he was thoroughly trained in the physical and chemical science of his day, and thus possessed, as much as any one in his time could possess it, the knowledge which is requisite for the just interpretation of geological phenomena, and the habit of thought which fits a man for scientific inquiry.

It is to this thorough scientific training that I ascribe Hutton's steady and persistent refusal to look to other causes than those now in operation, for the explanation of geological phenomena.

Thus he writes:–"I do not pretend, as he [M. de Luc] does in his theory, to describe the beginning of things. I take things such as I find them at present; and from these I reason with regard to that which must have been."[2]

[309] And again:–"A theory of the earth, which has for object truth, can have no retrospect to that which had preceded the present order of the world; for this order alone is what we have to reason upon; and to reason without data is nothing but delusion. A theory, therefore, which is limited to the actual constitution of this earth cannot be allowed to proceed one step beyond the present order of things."[3]

And so clear is he, that no causes beside such as are now in operation are needed to account for the

character and disposition of the components of the crust of the earth, that he says, broadly and boldly:–" . . . There is no part of the earth which has not had the same origin, so far as this consists in that earth being collected at the bottom of the sea, and afterwards produced, as land, along with masses of melted substances, by the operation of mineral causes."[4]

But other influences were at work upon Hutton beside those of a mind logical by nature, and scientific by sound training; and the peculiar turn which his speculations took seems to me to be unintelligible, unless these be taken into account. The arguments of the French astronomers and mathematicians, which, at the end of the last century, were held to demonstrate the existence of a compensating arrangement among the celestial bodies, whereby all perturba[310]tions eventually reduced themselves to oscillations on each side of a mean position, and the stability of the solar system was secured, had evidently taken strong hold of Hutton's mind.

In those oddly constructed periods which seem to have prejudiced many persons against reading his works, but which are full of that peculiar, if unattractive, eloquence which flows from mastery of the subject, Hutton says:–

"We have now got to the end of our reasoning; we have no data further to conclude immediately from that which actually is. But we have got enough; we have the satisfaction to find, that in Nature there is wisdom, system, and consistency. For having, in the natural history of this earth, seen a succession of worlds, we may from this conclude that there is a system in Nature; in like manner as, from seeing revolutions of the planets, it is concluded, that there is a system by which they are intended to continue those revolutions. But if the succession of worlds is established in the system of nature, it is in vain to look for anything higher in the origin of the earth. The result, therefore, of this physical inquiry is, that we find no vestige of a beginning,–no prospect of an end."[5]

Yet another influence worked strongly upon Hutton. Like most philosophers of his age, he coquetted with those final causes which have [311] been named barren virgins, but which might be more fitly termed the *hetairæ* of philosophy, so constantly have they led men astray. The final cause of the existence of the world is, for Hutton, the production of life and intelligence.

"We have now considered the globe of this earth as a machine, constructed upon chemical as well as mechanical principles, by which its different parts are all adapted, in form, in quality, and in quantity, to a certain end; an end attained with certainty or success; and an end from which we may perceive wisdom, in contemplating the means employed.

"But is this world to be considered thus merely as a machine, to last no longer than its parts retain their present position, their proper forms and qualities? Or may it not be also considered as an organised body? such as has a constitution in which the necessary decay of the machine is naturally repaired, in the exertion of those productive powers by which it had been formed.

"This is the view in which we are now to examine the globe; to see if there be, in the constitution of this

world, a reproductive operation, by which a ruined constitution may be again repaired, and a duration or stability thus procured to the machine, considered as a world sustaining plants and animals."[6]

[312] Kirwan, and the other Philistines of the day, accused Hutton of declaring that his theory implied that the world never had a beginning, and never differed in condition from its present state. Nothing could be more grossly unjust, as he expressly guards himself against any such conclusion in the following terms:–

"But in thus tracing back the natural operations which have succeeded each other, and mark to us the course of time past, we come to a period in which we cannot see any farther. This, however, is not the beginning of the operations which proceed in time and according to the wise economy of this world; nor is it the establishing of that which, in the course of time, had no beginning; it is only the limit of our retrospective view of those operations which have come to pass in time, and have been conducted by supreme intelligence."[7]

I have spoken of Uniformitarianism as the doctrine of Hutton and of Lyell. If I have quoted the older writer rather than the newer, it is because his works are little known, and his claims on our veneration too frequently forgotten, not because I desire to dim the fame of his eminent successor. Few of the present generation of geologists have read Playfair's "Illustrations," ever still the original "Theory of the Earth"; the more is the pity; but which of us has not thumbed [313] every page of the "Principles of Geology"? I think that he who writes fairly the history of his own progress in geological thought, will not be able to separate his debt to Hutton from his obligations to Lyell; and the history of the progress of individual geologists is the history of geology.

No one can doubt that the influence of uniformitarian views has been enormous, and, in the main, most beneficial and favourable to the progress of sound geology.

Nor can it be questioned that Uniformitarianism has even a stronger title than Catastrophism to call itself the geological speculation of Britain, or, if you will, British popular geology. For it is eminently a British doctrine, and has even now made comparatively little progress on the continent of Europe. Nevertheless, it seems to me to be open to serious criticism upon one of its aspects.

I have shown how unjust was the insinuation that Hutton denied a beginning to the world. But it would not be unjust to say that he persistently in practice, shut his eyes to the existence of that prior and different state of things which, in theory, he admitted; and, in this aversion to look beyond the veil of stratified rocks, Lyell follows him.

Hutton and Lyell alike agree in their indisposition to carry their speculations a step beyond [314] the period recorded in the most ancient strata now open to observation in the crust of the earth. This is, for Hutton, "the point in which we cannot see any farther"; while Lyell tells us,–

"The astronomer may find good reasons for ascribing the earth's form to the original fluidity of the mass, in times long antecedent to the first introduction of living beings into the planet; but the geologist must be content to regard the earliest monuments which it is his task to interpret, as belonging to a period when the crust had already acquired great solidity and thickness, probably as great as it now possesses, and when volcanic rocks, not essentially differing from those now produced, were formed from time to time, the intensity of volcanic heat being neither greater nor less than it is now."[8]

And again, "As geologists, we learn that it is not only the present condition of the globe which has been suited to the accommodation of myriads of living creatures, but that many former states also have been adapted to the organisation and habits of prior races of beings. The disposition of the seas, continents and islands, and the climates, have varied; the species likewise have been changed; and yet they have all been so modelled, on types analogous to those of existing plants and animals, as to indicate, throughout, a perfect harmony of design and unity of purpose. To [315] assume that the evidence of the beginning, or end, of so vast a scheme lies within the reach of our philosophical inquiries, or even of our speculations, appears to be inconsistent with a just estimate of the relations which subsist between the finite powers of man and the attributes of an infinite and eternal Being."[9]

The limitations implied in these passages appear to me to constitute the weakness and the logical defect of Uniformitarianism. No one will impute blame to Hutton that, in face of the imperfect condition, in his day, of those physical sciences which furnish the keys to the riddles of geology, he should have thought it practical wisdom to limit his theory to an attempt to account for "the present order of things"; but I am at a loss to comprehend why, for all time, the geologist must be content to regard the oldest fossiliferous rocks as the *ultima Thule* of his science; or what there is inconsistent with the relations between the finite and the infinite mind, in the assumption, that we may discern somewhat of the beginning, or of the end, of this speck in space we call our earth. The finite mind is certainly competent to trace out the development of the fowl within the egg; and I know not on what ground it should find more difficulty in unravelling the complexities of the development of the earth. In fact, as Kant [316] has well remarked,[10] the cosmical process is really simpler than the biological.

This attempt to limit, at a particular point, the progress of inductive and deductive reasoning from the things which are, to those which were–this faithlessness to its own logic, seems to me to have cost Uniformitarianism the place, as the permanent form of geological speculation, which it might otherwise have held.

It remains that I should put before you what I understand to be the third phase of geological speculation–namely, Evolutionism.

I shall not make what I have to say on this head clear, unless I diverge, or seem to diverge, for a while, from the direct path of my discourse, so far as to explain what I take to be the scope of geology itself. I conceive geology to be the history of the earth, in precisely the same sense as biology is the history of living beings; and I trust you will not think that I am overpowered by the influence of a dominant pursuit if I say that I trace a close analogy between these two histories.

If I study a living being, under what heads does the knowledge I obtain fall? I can learn its structure, or what we call its Anatomy; and its [317] Development, or the series of changes which it passes through to acquire its complete structure. Then I find that the living being has certain powers resulting from its own activities, and the interaction of these with the activities of other things–the knowledge of which is Physiology. Beyond this the living being has a position in space and time, which is its Distribution. All these form the body of ascertainable facts which constitute the *status quo* of the living creature. But these facts have their causes; and the ascertainment of these causes is the doctrine of Ætiology.

If we consider what is knowable about the earth, we shall find that such earth-knowledge–if I may so translate the word geology–falls into the same categories.

What is termed stratigraphical geology is neither more nor less than the anatomy of the earth; and the history of the succession of the formations is the history of a succession of such anatomies, or corresponds with development, as distinct from generation.

The internal heat of the earth, the elevation and depression of its crust, its belchings forth of vapours, ashes, and lava, are its activities, in as strict a sense as are warmth and the movements and products of respiration the activities of an animal. The phenomena of the seasons, of the trade winds, of the Gulf-stream, are as much the [318] results of the reaction between these inner activities and outward forces, as are the budding of the leaves in spring and their falling in autumn the effects of the interaction between the organisation of a plant and the solar light and heat. And, as the study of the activities of the living being is called its physiology, so are these phenomena the subject-matter of an analogous telluric physiology, to which we sometimes give the name of meteorology, sometimes that of physical geography, sometimes that of geology. Again, the earth has a place in space and in time, and relations to, other bodies in both these respects, which constitute its distribution. This subject is usually left to the astronomer; but a knowledge of its broad outlines seems to me to be an essential constituent of the stock of geological ideas.

All that can be ascertained concerning the structure, succession of conditions, actions, and position in space of the earth, is the matter of fact of its natural history. But, as in biology, there remains the matter of reasoning from these facts to their causes, which is just as much science as the other, and indeed more; and this constitutes geological ætiology.

Having regard to this general scheme of geological knowledge and thought, it is obvious that geological speculation may be, so to speak, anatomical and developmental speculation, so far as it relates to points of stratigraphical arrangement [319] which are out of reach of direct observation; or, it may be physiological speculation so far as it relates to undetermined problems relative to the activities of the earth; or, it may be distributional speculation, if it deals with modifications of the earth's place in space; or, finally, it will be ætiological speculation if it attempts to deduce the history of the world, as a whole, from the known properties of the matter of the earth, in the conditions in which the earth has been placed.

For the purposes of the present discourse I may take this last to be what is meant by "geological speculation."

Now Uniformitarianism, as we have seen, tends to ignore geological speculation in this sense altogether.

The one point the catastrophists and the uniformitarians agreed upon, when this Society was founded, was to ignore it. And you will find, if you look back into our records, that our revered fathers in geology plumed themselves a good deal upon the practical sense and wisdom of this proceeding. As a temporary measure, I do not presume to challenge its wisdom; but in all organised bodies temporary changes are apt to produce permanent effects; and as time has slipped by, altering all the conditions which may have made such mortification of the scientific flesh desirable, I think the effect of the stream of cold water which has steadily flowed over geological [320] speculation within these walls has been of doubtful beneficence.

The sort of geological speculation to which I am now referring (geological ætiology, in short) was created, as a science, by that famous philosopher Immanuel Kant, when, in 1775, he wrote his "General Natural History and Theory of the Celestial Bodies; or an Attempt to account for the Constitutional and the Mechanical Origin of the Universe upon Newtonian principles."[11]

In this very remarkable but seemingly little-known treatise,[12] Kant expounds a complete cosmogony, in the shape of a theory of the causes which have led to the development of the universe from diffused atoms of matter endowed with simple attractive and repulsive forces.

"Give me matter," says Kant, "and I will build the world;" and he proceeds to deduce from the simple data from which he starts, a doctrine in all essential respects similar to the well-known "Nebular Hypothesis" of Laplace.[13] He accounts for the relation of the masses and the densities of the planets to their distances from the sun, for the eccentricities of their orbits, for their rotations, for [321]their satellites, for the general agreement in the direction of rotation among the celestial bodies, for Saturn's ring, and for the zodiacal light. He finds in each system of worlds, indications that the attractive force of the central mass will eventually destroy its organisation, by concentrating upon itself the matter of the whole system; but, as the result of this concentration, he argues for the development of an amount of heat which will dissipate the mass once more into a molecular chaos such as that in which it began.

Kant pictures to himself the universe as once an infinite expansion of formless and diffused matter. At one point of this he supposes a single centre of attraction set up; and, by strict deductions from admitted dynamical principles, shows how this must result in the development of a prodigious central body, surrounded by systems of solar and planetary worlds in all stages of development. In vivid language he depicts the great world-maelstrom, widening the margins of its prodigious eddy in the slow progress of millions of ages, gradually reclaiming more and more of the molecular waste, and converting chaos into cosmos. But what is gained at the margin is lost in the centre; the attractions of the central systems bring their constituents together, which then, by the heat evolved, are converted once more into molecular

chaos. Thus the worlds that are, lie between the ruins of the worlds that have been, [322] and the chaotic materials of the worlds that shall be; and in spite of all waste and destruction, Cosmos is extending his borders at the expense of Chaos.

Kant's further application of his views to the earth itself is to be found in his "Treatise on Physical Geography"[14] (a term under which the then unknown science of geology was included), a subject which he had studied with very great care and on which he lectured for many years. The fourth section of the first part of this Treatise is called "History of the great Changes which the Earth has formerly undergone and is still undergoing," and is, in fact, a brief and pregnant essay upon the principles of geology. Kant gives an account first "of the gradual changes which are now taking place" under the heads of such as are caused by earthquakes, such as are brought about by rain and rivers, such as are effected by the sea, such as are produced by winds and frost; and, finally, such as result from the operations of man.

The second part is devoted to the "Memorials of the Changes which the Earth has undergone in remote Antiquity." These are enumerated as:–A. Proofs that the sea formerly covered the whole earth. B. Proofs that the sea has often been changed into dry land and then again into sea. C. A discussion of the various theories of the [323] earth put forward by Scheuchzer, Moro, Bonnet, Woodward, White, Leibnitz, Linnæus, and Buffon.

The third part contains an "Attempt to give a sound explanation of the ancient history of the earth."

I suppose that it would be very easy to pick holes in the details of Kant's speculations, whether cosmological, or specially telluric, in their application. But for all that, he seems to me to have been the first person to frame a complete system of geological speculation by founding the doctrine of evolution.

With as much truth as Hutton, Kant could say, "I take things just as I find them at present, and, from these, I reason with regard to that which must have been." Like Hutton, he is never tired of pointing out that "in Nature there is wisdom, system, and consistency." And, as in these great principles, so in believing that the cosmos has a reproductive operation "by which a ruined constitution may be repaired," he forestalls Hutton; while, on the other hand, Kant is true to science. He knows no bounds to geological speculation but those of the intellect. He reasons back to a beginning of the present state of things; he admits the possibility of an end.

I have said that the three schools of geological speculation which I have termed Catastrophism, Uniformitarianism, and Evolutionism, are commonly supposed to be antagonistic to one another; [324] and I presume it will have become obvious that in my belief, the last is destined to swallow up the other two. But it is proper to remark that each of the latter has kept alive the tradition of precious truths.

Catastrophism has insisted upon the existence of a practically unlimited bank of force, on which the theorist might draw; and it has cherished the idea of the development of the earth from a state in which its form, and the forces which it exerted, were very different from those we now know. That such difference of form and power once existed is a necessary part of the doctrine of evolution.

Uniformitarianism, on the other hand, has with equal justice insisted upon a practically unlimited bank of time, ready to discount any quantity of hypothetical paper. It has kept before our eyes the power of the infinitely little, time being granted, and has compelled us to exhaust known causes, before flying to the unknown.

To my mind there appears to be no sort of necessary theoretical antagonism between Catastrophism and Uniformitarianism. On the contrary, it is very conceivable that catastrophes may be part and parcel of uniformity. Let me illustrate my case by analogy. The working of a clock is a model of uniform action; good time-keeping means uniformity of action. But the striking of the clock is essentially a catastrophe; the [325] hammer might be made to blow up a barrel of gunpowder, or turn on a deluge of water; and, by proper arrangement, the clock, instead of marking the hours, might strike at all sorts of irregular periods, never twice alike, in the intervals, force, or number of its blows. Nevertheless, all these irregular, and apparently lawless, catastrophes would be the result of an absolutely uniformitarian action; and we might have two schools of clock-theorists, one studying the hammer and the other the pendulum.

Still less is there any necessary antagonism between either of these doctrines and that of Evolution, which embraces all that is sound in both Catastrophism and Uniformitarianism, while it rejects the arbitrary assumptions of the one and the, as arbitrary, limitations of the other. Nor is the value of the doctrine of Evolution to the philosophic thinker diminished by the fact that it applies the same method to the living and the not-living world; and embraces, in one stupendous analogy, the growth of a solar system from molecular chaos, the shaping of the earth from the nebulous cub-hood of its youth, through innumerable changes and immeasurable ages, to its present form; and the development of a living being from the shapeless mass of protoplasm we term a germ.

I do not know whether Evolutionism can claim that amount of currency which would entitle it to be called British popular geology; but, more [326] or less vaguely, it is assuredly present in the minds of most geologists.

Such being the three phases of geological speculation, we are now in position to inquire which of these it is that Sir William Thomson calls upon us to reform in the passages which I have cited.

It is obviously Uniformitarianism which the distinguished physicist takes to be the representative of geological speculation in general. And thus a first issue is raised, inasmuch as many persons (and those not the least thoughtful among the younger geologists) do not accept strict Uniformitarianism as the final form of geological speculation. We should say, if Hutton and Playfair declare the course of the world to have been always the same, point out the fallacy by all means; but, in so doing, do not imagine that you are proving modern geology to be in opposition to natural philosophy. I do not suppose that, at the present day, any geologist would be found to maintain absolute Uniformitarianism, to deny that the rapidity of the rotation of the earth *may* be diminishing, that the sun *may* be waxing dim, or that the earth itself *may* be cooling. Most of us, I suspect, are Gallios, "who care for none of these things," being of opinion that, true or fictitious, they have made no practical difference to the earth, during the period [327] of which a record is preserved in stratified deposits.

The accusation that we have been running counter to the *principles* of natural philosophy, therefore, is devoid of foundation. The only question which can arise is whether we have, or have not, been tacitly making assumptions which are in opposition to certain conclusions which may be drawn from those principles. And this question subdivides itself into two:–the first, are we really contravening such conclusions? the second, if we are, are those conclusions so firmly based that we may not contravene them? I reply in the negative to both these questions, and I will give you my reasons for so doing. Sir William Thomson believes that he is able to prove, by physical reasonings, "that the existing state of things on the earth, life on the earth–all geological history showing continuity of life–must be limited within some such period of time as one hundred million years" (*loc. cit.* p. 25).

The first inquiry which arises plainly is, has it ever been denied that this period *may* be enough for the purposes of geology?

The discussion of this question is greatly embarrassed by the vagueness with which the assumed limit is, I will not say defined, but indicated,–"some such period of past time as one hundred million years." Now does this mean [328] that it may have been two, or three, or four hundred million years? Because this really makes all the difference.[15]

I presume that 100,000 feet may be taken as a full allowance for the total thickness of stratified rocks containing traces of life; 100,000 divided by 100,000,000=0.001. Consequently, the deposit of 100,000 feet of stratified rock in 100,000,000 years means that the deposit has taken place at the rate of 1/1000 of a foot, or, say, 1/83 of an inch, per annum.

Well, I do not know that any one is prepared to maintain that, even making all needful allowances, the stratified rocks may not have been formed, on the average, at the rate of 1/83 of an inch per annum. I suppose that if such could be shown to be the limit of world-growth, we could put up with the allowance without feeling that our speculations had undergone any revolution. And perhaps, after all, the qualifying phrase "some such period" may not necessitate the assumption of more than 1/166 or 1/249 or 1/332 of an inch of deposit per year, which, of course, would give us still more ease and comfort.

But, it may be said, that it is biology, and not geology, which asks for so much time–that the succession of life demands vast intervals; but [329] this appears to me to be reasoning in a circle. Biology takes her time from geology. The only reason we have for believing in the slow rate of the change in living forms is the fact that they persist through a series of deposits which, geology informs us, have taken a long while to make. If the geological clock is wrong, all the naturalist will have to do is to modify his notions of the rapidity of change accordingly. And I venture to point out that, when we are told that the limitation of the period during which living beings have inhabited this planet to one, two, or three hundred million years requires a complete revolution in geological speculation, the *onus probandi* rests on the maker of the assertion, who brings forward not a shadow of evidence in its support.

Thus, if we accept the limitation of time placed before us by Sir W. Thomson, it is not obvious, on the

face of the matter, that we shall have to alter, or reform, our ways in any appreciable degree; and we may therefore proceed with much calmness, and indeed much indifference, as to the result, to inquire whether that limitation is justified by the arguments employed in its support.

These arguments are three in number:–

l. The first is based upon the undoubted fact that the tides tend to retard the rate of the earth's rotation upon its axis. That this must [330] be so is obvious, if one considers, roughly, that the tides result from the pull which the sun and the moon exert upon the sea, causing it to act as a sort of break upon the rotating solid earth.

Kant, who was by no means a mere "abstract philosopher," but a good mathematician and well versed in the physical science of his time, not only proved this in an essay of exquisite clearness and intelligibility, now more than a century old,[16] but deduced from it some of its more important consequences, such as the constant turning of one face of the moon towards the earth.

But there is a long step from the demonstration of a tendency to the estimation of the practical value of that tendency, which is all with which we are at present concerned. The facts bearing on this point appear to stand as follows:–

It is a matter of observation that the moon's mean motion is (and has for the last 3,000 years been) undergoing an acceleration, relatively to the rotation of the earth. Of course this may result from one of two causes: the moon may really have been moving more swiftly in its orbit; or the earth may have been rotating more slowly on its axis.

[331] Laplace believed he had accounted for this phenomenon by the fact that the eccentricity of the earth's orbit has been diminishing throughout these 3,000 years. This would produce a diminution of the mean attraction of the sun on the moon; or, in other words, an increase in the attraction of the earth on the moon; and, consequently, an increase in the rapidity of the orbital motion of the latter body. Laplace, therefore, laid the responsibility of the acceleration upon the moon, and if his views were correct, the tidal retardation must either be insignificant in amount, or be counteracted by some other agency.

Our great astronomer, Adams, however, appears to have found a flaw in Laplace's calculation, and to have shown that only half the observed retardation could be accounted for in the way he had suggested. There remains, therefore, the other half to be accounted for; and here, in the absence of all positive knowledge, three sets of hypotheses have been suggested.

(*a.*) M. Delaunay suggests that the earth is at fault, in consequence of the tidal retardation. Messrs Adams, Thomson, and Tait work out this suggestion, and, "on a certain assumption as to the proportion of retardations due to the sun and moon," find the earth may lose twenty-two seconds of time in a century from this cause.[17]

(*b.*) But M. Dufour suggests that the retardation [332] of the earth (which is hypothetically assumed to exist) may be due in part, or wholly, to the increase of the moment of inertia of the earth by meteors falling upon its surface. This suggestion also meets with the entire approval of Sir W. Thomson, who shows that meteor-dust, accumulating at the rate of one foot in 4,000 years, would account for the remainder of retardation.[18]

(*c.*) Thirdly, Sir W. Thomson brings forward an hypothesis of his own with respect to the cause of the hypothetical retardation of the earth's rotation:–

"Let us suppose ice to melt from the polar regions (20° round each pole, we may say) to the extent of something more than a foot thick, enough to give 1.1 foot of water over those areas, or 0.006 of a foot of water if spread over the whole globe, which would, in reality, raise the sea-level by only some such undiscoverable difference as three-fourths of an inch or an inch. This, or the reverse, which we believe might happen any year, and could certainly not be detected without far more accurate observations and calculations for the mean sea-level than any hitherto made, would slacken or quicken the earth's rate as a timekeeper by one-tenth of a second per year."[19]

I do not presume to throw the slightest doubt upon the accuracy of any of the calculations made by such distinguished mathematicians as those [333] who have made the suggestions I have cited. On the contrary, it is necessary to my argument to assume that they are all correct. But I desire to point out that this seems to be one of the many cases in which the admitted accuracy of mathematical process is allowed to throw a wholly inadmissible appearance of authority over the results obtained by them. Mathematics may be compared to a mill of exquisite workmanship, which grinds you stuff of any degree of fineness; but, nevertheless, what you get out depends upon what you put in; and as the grandest mill in the world will not extract wheat-flour from peascods, so pages of formulæ will not get a definite result out of loose data.

In the present instance it appears to be admitted:–

1. That it is not absolutely certain, after all, whether the moon's mean motion is undergoing acceleration, or the earth's rotation retardation. And yet this is the key of the whole position.

2. If the rapidity of the earth's rotation is diminishing, it is not certain how much of that retardation[20] is due to tidal friction, how much to meteors,–how much to possible excess of melting over accumulation of polar ice, during the period covered by observation, which amounts, at the outside, to not more than 2,600 years.

[334] 3. The effect of a different distribution of land and water in modifying the retardation caused by tidal friction, and of reducing it, under some circumstances, to a minimum, does not appear to be taken into account.

4. During the Miocene epoch the polar ice was certainly many feet thinner than it has been during, or since, the Glacial epoch. Sir W. Thomson tells us that the accumulation of something more than a foot of ice around the poles (which implies the withdrawal of, say, an inch of water from the general surface of the sea) will cause the earth to rotate quicker by one-tenth of a second per annum. It would appear, therefore, that the earth may have been rotating, throughout the whole period which has elapsed from the commencement of the Glacial epoch down to the present time, one, or more, seconds per annum quicker than it rotated during the Miocene epoch.

But, according to Sir W. Thomson's calculation, tidal retardation will only account for a retardation of 22" in a century, or 22/100 (say 1/2) of a second per annum.

Thus, assuming that the accumulation of polar ice since the Miocene epoch has only been sufficient to produce ten times the effect of a coat of ice one foot thick, we shall have an accelerating cause which covers all the loss from tidal action, and leaves a balance of 4/5 of a second per annum in the way of acceleration.

[335] If tidal retardation can be thus checked and overthrown by other temporary conditions, what becomes of the confident assertion, based upon the assumed uniformity of tidal retardation, that ten thousand million years ago the earth must have been rotating more than twice as fast as at present, and, therefore, that we geologists are "in direct opposition to the principles of Natural Philosophy" if we spread geological history over that time?

II. The second argument is thus stated by Sir W. Thomson:–"An article, by myself, published in 'Macmillan's Magazine' for March 1862, on the age of the sun's heat, explains results of investigation into various questions as to possibilities regarding the amount of heat that the sun could have, dealing with it as you would with a stone, or a piece of matter, only taking into account the sun's dimensions, which showed it to be possible that the sun may have already illuminated the earth for as many as one hundred million years, but at the same time rendered it almost certain that he had not illuminated the earth for five hundred millions of years. The estimates here are necessarily very vague; but yet, vague as they are, I do not know that it is possible, upon any reasonable estimate founded on known properties of matter, to say that we can believe the sun has really illuminated the earth for five hundred million years."[21]

[336] I do not wish to "Hansardise" Sir William Thomson by laying much stress on the fact that, only fifteen years ago he entertained a totally different view of the origin of the sun's heat, and believed that the energy radiated from year to year was supplied from year to year–a doctrine which would have suited Hutton perfectly. But the fact that so eminent a physical philosopher has, thus recently, held views opposite to those which he now entertains, and that he confesses his own estimates to be "very vague," justly entitles us to disregard those estimates, if any distinct facts on our side go against them. However, I am not aware that such facts exist. As I have already said, for anything I know, one, two, or three hundred millions of years may serve the needs of geologists perfectly well.

III. The third line of argument is based upon the temperature of the interior of the earth. Sir W. Thomson refers to certain investigations which prove that the present thermal condition of the interior of the earth implies either a heating of the earth within the last 20,000 years of as much as 100° F., or a greater heating all over the surface at some time further back than 20,000 years, and then proceeds thus:–

"Now, are geologists prepared to admit that; at some time within the last 20,000 years, there has been all over the earth so high a temperature as that? I presume not; no geologist–no *modern* [337] geologist–would for a moment admit the hypothesis that the present state of underground heat is due to a heating of the surface at so late a period as 20,000 years ago. If that is not admitted we are driven to a greater heat at some time more than 20,000 years ago. A greater heating all over the surface than 100° Fahrenheit would kill nearly all existing plants and animals, I may safely say. Are modern geologists prepared to say that all life was killed off the earth 50,000, 100,000, or 200,000 years ago? For the uniformity theory, the further back the time of high surface-temperature is put the better; but the further back the time of heating, the hotter it must have been. The best for those who draw most largely on time is that which puts it furthest back; and that is the theory that the heating was enough to melt the whole. But even if it was enough to melt the whole, we must still admit some limit, such as fifty million years, one hundred million years, or two or three hundred million years ago. Beyond that we cannot go."[22]

It will be observed that the "limit" is once again of the vaguest, ranging from 50,000,000 years to 300,000,000. And the reply is, once more, that, for anything that can be proved to the contrary, one or two hundred million years might serve the purpose, even of a thoroughgoing Huttonian uniformitarian, very well.

[338] But if, on the other hand, the 100,000,000 or 200,000,000 years appear to be insufficient for geological purposes, we must closely criticise the method by which the limit is reached. The argument is simple enough. *Assuming* the earth to be nothing but a cooling mass, the quantity of heat lost per year, *supposing* the rate of cooling to have been uniform, multiplied by any given number of years, will be given the minimum temperature that number of years ago.

But is the earth nothing but a cooling mass, "like a hot-water jar such as is used in carriages," or "a globe of sandstone," and has its cooling been uniform? An affirmative answer to both these questions seems to be necessary to the validity of the calculations on which Sir W. Thomson lays so much stress.

Nevertheless it surely may be urged that such affirmative answers are purely hypothetical, and that other suppositions have an equal right to consideration.

For example, is it not possible that, at the prodigious temperature which would seem to exist at 100 miles below the surface, all the metallic bases may behave as mercury does at a red heat, when it refuses to combine with oxygen; while, nearer the surface, and therefore at a lower temperature, they may enter into combination (as mercury does with oxygen a few degrees below its boiling-point), and so give rise to a heat totally [339] distinct from that which they possess as cooling bodies? And has it not also been proved by recent researches that the quality of the atmosphere may immensely affect its permeability to

heat; and, consequently, profoundly modify the rate of cooling the globe as a whole?

I do not think it can be denied that such conditions may exist, and may so greatly affect the supply, and the loss, of terrestrial heat as to destroy the value of any calculations which leave them out of sight.

My functions as your advocate are at an end. I speak with more than the sincerity of a mere advocate when I express the belief that the case against us has entirely broken down. The cry for reform which has been raised without, is superfluous, inasmuch as we have long been reforming from within, with all needful speed. And the critical examination of the grounds upon which the very grave charge of opposition to the principles of Natural Philosophy has been brought against us, rather shows that we have exercised a wise discrimination in declining, for the present, to meddle with our foundations.

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[1] On Geological Time. By Sir W. Thomson, LL.D. *Transactions of the Geological Society of Glasgow*, vol. iii.

[2] *The Theory of the Earth,* vol. i, p. 173, note.

[3] *Ibid.*. vol. i. p. 281.

[4] *Ibid.*. p. 371.

[5] *Ibid.*. vol. i. p. 200.

[6] *Ibid.*. vol. i. pp. 16, 17.

[7] *Ibid.*. vol. i. p. 223.

[8] *Principles of Geology,* vol. ii. p. 211.

[9] *Ibid.* vol. ii. p. 613.

[10] "Man darf es sich also nicht befremden lassen, wenn ich mich unterstehe zu sagen, dass eher die Bildung aller Himmelskörper, die Ursache ihren Bewegungen, kurz der Unsprung der gantzen gegenwärtigen Verfassung des Weltbaues werden können eingesehen werden, ehe die Erzeugung eines einzigen Krautes oder einer Raupe aus mechanischen Gründen, deutlich und vollständig kund werden wird."–Kant's *Sämmtliche Werke,* Bd. i. p. 220.

[11] Grant (*History of Physical Astronomy*, p. 574) makes but the briefest reference to Kant.

[12] "Allgemeine Naturgeschichte und Theorie des Himmels; odor Versuch von der Verfassung und dem mechanischen Ursprunge des ganzen Weltgebäudes nach Newton'schen Grundsatzen abgehandelt."–Kant's *Sämmtliche Werke*, Bd. i. p. 207.

[13] *Système du Monde*, tome ii. chap. 6.

[14] Kant's *Sämmtliche Werke*, Bd. viii. p. 145.

[15] Sir William Thomson implies (*loc. cit.* p. 16) that the precise time is of no consequence: "the principle is the same"; but, as the principle is admitted, the whole discussion turns on its practical results.

[16] "Untersuchung der Frage ob die Erde in ihrer Umdrehung un die Achse, wodurch sie die Abwechselung des Tages und der Nacht hervorbringt, einige Veränderung seit den ersten Zeiten ihres Ursprunges erlitten habe, &c." Kant's *Sämmtliche Werke*, Bd. i. p. 178.

[17] Sir W. Thomson, *loc. cit.* p. 14.

[18] *Ibid.* p. 27.

[19] *Ibid.*

[20] It will be understood that I do not wish to deny that the earth's rotation *may be* undergoing retardation.

[21] *Loc. cit.* p. 20.

[22] *Loc. cit.* p. 24.

THE HUXLEY FILE

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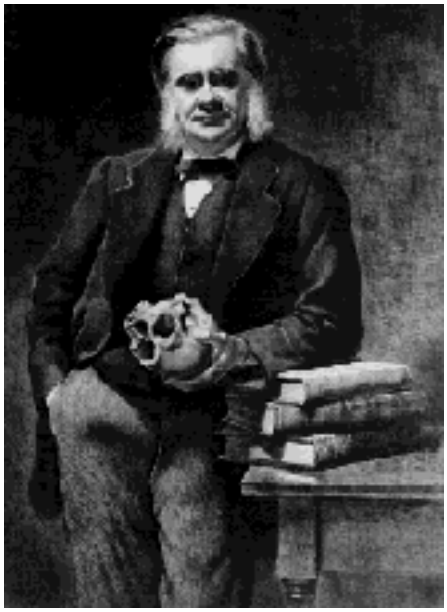

Palæontology and the Doctrine of Evolution (1870)

Collected Essays VIII

[340] It is now eight years since, in the absence of the late Mr. Leonard Horner, who then presided over us, it fell to my lot, as one of the Secretaries of this Society, to draw up the customary Annual Address. I availed myself of the opportunity to endeavour to "take stock" of that portion of the science of biology which is commonly called "palæontology," as it then existed; and, discussing one after another the doctrines held by palæontologists, I put before you the results of my attempts to sift the well-established from the hypothetical or the doubtful. Permit me briefly to recall to your minds what those results were:–

1. The living population of all parts of the earth's surface which have yet been examined [341] has undergone a succession of changes which, upon the whole, have been of a slow and gradual character.

2. When the fossil remains which are the evidences of these successive changes, as they have occurred in any two more or less distant parts of the surface of the earth, are compared, they exhibit a certain broad and general parallelism. In other words, certain forms of life in one locality occur in the same general order of succession as, or are *homotaxial* with, similar forms in the other locality.

3. Homotaxis is not to be held identical with synchronism without independent evidence. It is possible that similar, or even identical, faunæ and floræ in two different localities may be of extremely different ages, if the term "age" is used in its proper chronological sense. I stated that "geographical provinces, or zones, may have been as distinctly marked in the Palæozoic epoch as at present; and those seemingly sudden appearances of new genera and species which we ascribe to new creation, may be simple results of migration."

4. The opinion that the oldest known fossils are the earliest forms of life has no solid foundation.

5. If we confine ourselves to positively ascertained facts, the total amount of change in the forms of animal and vegetable life, since the [342] existence of such forms is recorded, is small. When compared with the lapse of time since the first appearance of these forms, the amount of change is wonderfully small. Moreover, in each great group of the animal and vegetable kingdoms, there are certain forms which I termed Persistent Types, which have remained, with but very little apparent change, from their first appearance to the present time.

6. In answer to the question "What, then, does an impartial survey of the positively ascertained truths of palæontology testify in relation to the common doctrines of progressive modification, which suppose that modification to have taken place by a necessary progress from more to less embryonic forms, from more to less generalised types, within the limits of the period represented by the fossiliferous rocks?" I reply, "It negatives these doctrines; for it either shows us no evidence of such modification, or demonstrates such modification as has occurred to have been very slight; and, as to the nature of that

modification, it yields no evidence whatsoever that the earlier members of any long-continued group were more generalised in structure than the later ones."

I think that I cannot employ my last opportunity of addressing you, officially, more properly–I may say more dutifully–than in revising these old judgments with such help as further know[343]ledge and reflection, and an extreme desire to get at the truth, may afford me.

1. With respect to the first proposition, I may remark that whatever may be the case among the physical geologists, catastrophic palæontologists are practically extinct. It is now no part of recognised geological doctrine that the species of one formation all died out and were replaced by a brand-new set in the next formation. On the contrary, it is generally, if not universally, agreed that the succession of life has been the result of a slow and gradual replacement of species by species; and that all appearances of abruptness of change are due to breaks in the series of deposits, or other changes in physical conditions. The continuity of living forms has been unbroken from the earliest times to the present day.

2, 3. The use of the word "homotaxis" instead of "synchronism" has not, so far as I know, found much favour in the eyes of geologists. I hope, therefore, that it is a love for scientific caution, and not mere personal affection for a bantling of my own, which leads me still to think that the change of phrase is of importance, and that the sooner it is made, the sooner shall we get rid of a number of pitfalls which beset the reasoner upon the facts and theories of geology.

One of the latest pieces of foreign intelligence which has reached us is the information that the Austrian geologists have, at last, succumbed to [344] the weighty evidence which M. Barrande has accumulated, and have admitted the doctrine of colonies. But the admission of the doctrine of colonies implies the further admission that even identity of organic remains is no proof of the synchronism of the deposits which contain them.

4. The discussions touching the *Eozoon*, which commenced in 1864, have abundantly justified the fourth proposition. In 1862, the oldest record of life was in the Cambrian rocks; but if the *Eozoon* be, as Principal Dawson and Dr. Carpenter have shown so much reason for believing, the remains of a living being, the discovery of its true nature carried life back to a period which, as Sir William Logan has observed, is as remote from that during which the Cambrian rocks were deposited, as the Cambrian epoch itself is from the tertiaries. In other words, the ascertained duration of life upon the globe was nearly doubled at a stroke.

5. The significance of persistent types, and of the small amount of change which has taken place even in those forms which can be shown to have been modified, becomes greater and greater in my eyes, the longer I occupy myself with the biology of the past.

Consider how long a time has elapsed since the Miocene epoch. Yet, at that time there is reason to believe that every important group in every order of the *Mammalia* was represented. Even the [345] comparatively scanty Eocene fauna yields examples of the orders *Cheiroptera, Insectivora, Rodentia,*

and *Perissodactyla;* of *Artiodactyla* under both the Ruminant and the Porcine modifications; of *Carnivora*, *Cetacea*, and *Marsupialia.*

Or, if we go back to the older half of the Mesozoic epoch, how truly surprising it is to find every order of the *Reptilia*, except the *Ophidia*, represented; while some groups, such as the *Ornithoscelida* and the *Pterosauria*, more specialised than any which now exist, abounded.

There is one division of the *Amphibia* which offers especially important evidence upon this point, inasmuch as it bridges over the gap between the Mesozoic and the Palæozoic formations (often supposed to be of such prodigious magnitude), extending, as it does, from the bottom of the Carboniferous series to the top of the Trias, if not into the Lias. I refer to the Labyrinthodonts. As the Address of 1862 was passing through the press, I was able to mention, in a note, the discovery of a large Labyrinthodont, with well-ossified vertebræ, in the Edinburgh coal-field. Since that time eight or ten distinct genera of Labyrinthodonts have been discovered in the Carboniferous rocks of England, Scotland, and Ireland, not to mention the American forms described by Principal Dawson and Professor Cope. So that, at the present time, the Labyrinthodont Fauna of the Carboniferous rocks is more [346] extensive and diversified than that of the Trias, while its chief types, so far as osteology enables us to judge, are quite as highly organised. Thus it is certain that a comparatively highly organised vertebrate type, such as that of the Labyrinthodonts, is capable of persisting, with no considerable change, through the period represented by the vast deposits which constitute the Carboniferous, the Permian, and the Triassic formations.

The very remarkable results which have been brought to light by the sounding and dredging operations, which have been carried on with such remarkable success by the expeditions sent out by our own, the American, and the Swedish Governments, under the supervision of able naturalists, have a bearing in the same direction. These investigations have demonstrated the existence, at great depths in the ocean, of living animals in some cases identical with, in others very similar to, those which are found fossilised in the white chalk. The *Globigerinæ*, Cyatholiths, Coccospheres, Discoliths in the one are absolutely identical with those in the other; there are identical, or closely analogous, species of Sponges, Echinoderms, and Brachiopods. Off the coast of Portugal, there now lives a species of *Beryx* which, doubtless, leaves its bones and scales here and there in the Atlantic ooze, as its predecessor left its spoils in the mud of the sea of the Cretaceous epoch.

[347] Many years ago[1] I ventured to speak of the Atlantic mud as "modern chalk," and I know of no fact inconsistent with the view which Professor Wyville Thomson has advocated, that the modern chalk is not only the lineal descendant of the ancient chalk, but that it remains, so to speak, in the possession of the ancestral estate; and that from the Cretaceous period (if not much earlier) to the present day, the deep sea has covered a large part of what is now the area of the Atlantic. But if *Globigerina*, and *Terebrutula caput-serpentis* and *Beryx*, not to mention other forms of animals and of plants, thus bridge over the interval between the present and the Mesozoic periods, is it possible that the majority of other living things underwent a "sea-change into something new and strange" all at once?

6. Thus far I have endeavoured to expand and to enforce by fresh arguments, but not to modify in any important respect, the ideas submitted to you on a former occasion. But when I come to the propositions touching progressive modification, it appears to me, with the help of the new light which has broken from various quarters, that there is much ground for softening the somewhat Brutus-like severity with which, in 1862, I dealt with a doctrine, for the truth of which I should have been glad enough to be able to find a good [348] foundation. So far, indeed, as the *Invertebrata* and the lower *Vertebrata* are concerned, the facts and the conclusions which are to be drawn from them appear to me to remain what they were. For anything that, as yet, appears to the contrary, the earliest known Marsupials may have been as highly organised as their living congeners; the Permian lizards show no signs of inferiority to those of the present day; the Labyrinthodonts cannot be placed below the living Salamander and Triton; the Devonian Ganoids are closely related to *Polypterus* and to *Lepidosiren*..

But when we turn to the higher *Vertebrata,* the results of recent investigations, however we may sift and criticise them, seem to me to leave a clear balance in favour of the doctrine of the evolution of living forms one from another. Nevertheless, in discussing this question, it is very necessary to discriminate carefully between the different kinds of evidence from fossil remains which are brought forward in favour of evolution.

Every fossil which takes an intermediate place between forms of life already known, may be said, so far as it is intermediate, to be evidence in favour of evolution, inasmuch as it shows a possible road by which evolution may have taken place. But the mere discovery of such a form does not, in itself, prove that evolution took place by and through it, nor does it constitute more than pre[349]sumptive evidence in favour of evolution in general. Suppose A, B, C to be three forms, while B is intermediate in structure between A and C. Then the doctrine of evolution offers four possible alternatives. A may have become C by way of B; or C may have become A by way of B; or A and C may be independent modifications of B; or A, B, and C may be independent modifications of some unknown D. Take the case of the Pigs, the *Anoplotheridæ*, and the Ruminants. The *Anoplotheridæ* are intermediate between the first and the last; but this does not tell us whether the Ruminants have come from the Pigs, or the Pigs from Ruminants, or both from *Anoplotheridæ*, or whether Pigs, Ruminants, and *Anoplotheridæ* alike may not have diverged from some common stock.

But if it can be shown that A, B, and C exhibit successive stages in the degree of modification, or specialisation, of the same type; and if, further, it can be proved that they occur in successively newer deposits, A being in the oldest and C in the newest, then the intermediate character of B has quite another importance, and I should accept it, without hesitation, as a link in the genealogy of C. I should consider the burden of proof to be thrown upon any one who denied C to have been derived from A by way of B, or in some closely analogous fashion; for it is always probable that one may not hit upon the exact line of filiation, [350] and, in dealing with fossils, may mistake uncles and nephews for fathers and sons.

I think it necessary to distinguish between the former and the latter classes of intermediate forms, as *intercalary types* and *linear types.* When I apply the former term, I merely mean to say that as a matter of fact, the form B, so named, is intermediate between the others, in the sense in which the

Anoplotherium is intermediate between the Pigs and the Ruminants–without either affirming, or denying, any direct genetic relation between the three forms involved. When I apply the latter term, on the other hand, I mean to express the opinion that the forms A, B, and C constitute a line of descent, and that B is thus part of the lineage of C.

From the time when Cuvier's wonderful researches upon the extinct Mammals of the Paris gypsum first made intercalary types known, and caused them to be recognised as such, the number of such forms has steadily increased among the higher *Mammalia.* Not only do we now know numerous intercalary forms of *Ungulata,* but M. Gaudry's great monograph upon the fossils of Pikermi (which strikes me as one of the most perfect pieces of palæontological work I have seen for a long time) shows us, among the *Primates, Mesopithcus* as an intercalary form between the *Semnopitheci and the Macaci;* and among the *Carnivora, Hyænictis* and *Ictitherium* as intercalary, [351] or, perhaps, linear types between the *Viverridæ* and the *Hyænidæ.*

Hardly any order of the higher *Mammalia* stands so apparently separate and isolated from the rest as that of the *Cetacea;* though a careful consideration of the structure of the pinnipede *Carnivora,* or Seals, shows, in them, many an approximation towards the still more completely marine mammals. The extinct *Zeuglodon,* however, presents us with an intercalary form between the type of the Seals and that of the Whales. The skull of this great Eocene sea-monster, in fact, shows by the narrow and prolonged interorbital region; the extensive union of the parietal bones in a sagittal suture; the well-developed nasal bones; the distinct and large incisors implanted in premaxillary bones, which take a full share in bounding the fore part of the gape; the two-fanged molar teeth with triangular and serrated crowns, not exceeding five on each side in each jaw; and the existence of a deciduous dentition–its close relation with the Seals. While, on the other hand, the produced rostral form of the snout, the long symphysis, and the low coronary process of the mandible are approximations to the cetacean form of those parts.

The scapula resembles that of the cetacean *Hyperoodon,* but the supra-spinous fossa is larger and more seal-like; as is the humerus, which differs from that of the *Cetacea* in presenting true [352] articular surfaces for the free jointing of the bones of the fore-arm. In the apparently complete absence of hinder limbs, and in the characters of the vertebral column, the *Zeuglodon* lies on the cetacean side of the boundary line; so that upon the whole, the Zeuglodonts, transitional as they are, are conveniently retained in the cetacean order. And the publication, in 1864, of M. Van Beneden's memoir on the Miocene and Pliocene *Squalodon* furnished much better means than anatomists previously possessed of fitting in another link of the chain which connects the existing *Cetacea* with *Zeuglodon.* The teeth are much more numerous, although the molars exhibit the zeuglodont double fang; the nasal bones are very short, and the upper surface of the rostrum presents the groove, filled up during life by the prolongation of the ethmoidal cartilage, which is so characteristic of the majority of the *Cetacea.*

It appears to me that, just as among the existing *Carnivora,* the walruses and the eared seals are intercalary forms between the fissipede Carnivora and the ordinary seals, so the Zeuglodonts are intercalary between the *Carnivora,* as a whole, and the *Cetacea.* Whether the Zeuglodonts are also linear types in their relation to these two groups cannot be ascertained, until we have more definite knowledge than we possess at present, respecting the relations in time of the *Carnivora* and *Cetacea.*

[353] Thus far we have been concerned with the intercalary types which occupy the intervals between Families or Orders of the same class; but the investigations which have been carried on by Professor Gegenbaur, Professor Cope, and myself into the structure and relations of the extinct reptilian forms of the *Ornithoscelida* (or *Dinosauria* and *Compsognatha*) have brought to light the existence of intercalary forms between what have hitherto been always regarded as very distinct classes of the vertebrate sub-kingdom, namely *Reptilia* and *Aves.* Whatever inferences may, or may not, be drawn from the fact, it is now an established truth that, in many of these *Ornithoscelida,* the hind limbs and the pelvis are much more similar to those of Birds than they are to those of Reptiles, and that these Bird-reptiles, or Reptile-birds, were more or less completely bipedal.

When I addressed you in 1862, I should have been bold indeed had I suggested that palæontology would before long show us the possibility of a direct transition from the type of the lizard to that of the ostrich. At the present moment, we have, in the *Ornithoscelida,* the intercalary type, which proves that transition to be something more than a possibility; but it is very doubtful whether any of the genera of *Ornithoscelida* with which we are at present acquainted are the actual linear types by which the transition from the [354] lizard to the bird was effected. These, very probably, are still hidden from us in the older formations.

Let us now endeavour to find some cases of true linear types, or forms which are intermediate between others because they stand in a direct genetic relation to them. It is no easy matter to find clear and unmistakable evidence of filiation among fossil animals; for, in order that such evidence should be quite satisfactory, it is necessary that we should be acquainted with all the most important features of the organisation of the animals which are supposed to be thus related, and not merely with the fragments upon which the genera and species of the palæontologist are so often based. M. Gaudry has arranged the species of *Hyænidæ, Proboscidea, Rhinocerotidæ,* and *Equidæ,* in their order of filiation from their earliest appearance in the Miocene epoch to the present time, and Professor Rutimeyer has drawn up similar schemes for the Oxen and other *Ungulata*–with what, I am disposed to think, is a fair and probable approximation to the order of nature. But, as no one is better aware than these two learned, acute, and philosophical biologists, all such arrangements must be regarded as provisional, except in those cases in which, by a fortunate accident, large series of remains are obtainable from a thick and widespread series of deposits. It is easy to accumulate probabilities–hard to make out some [355] particular case in such a way that it will stand rigorous criticism.

After much search, however, I think that such a case is to be made out in favour of the pedigree of the Horses.

The genus *Equus* is represented as far back as the latter part of the Miocene epoch; but in deposits belonging to the middle of that epoch its place is taken by two other genera, Hipparion and *Anchitherium;*[2] and, in the lowest Miocene and upper Eocene, only the last genus occurs A species of *Anchitherium* was referred by Cuvier to the *Palæotheria* under the name of *P. aurelianense.* The grinding-teeth are in fact very similar in shape and in pattern, and in the absence of any thick layer of

cement, to those of some species of *Palæotherium,* especially Cuvier's *Palæotherium minus,* which has been formed into a separate genus, *Plagiolophus,* by Pomel. But in the fact that there are only six full-sized grinders in the lower jaw, the first premolar being very small; that the anterior grinders are as large as, or rather larger than, the posterior ones; that the [356] second premolar has an anterior prolongation; and that the posterior molar of the lower jaw has, as Cuvier pointed out, a posterior lobe of much smaller size and different form, the dentition of *Anchitherium* departs from the type of the *Palæotherium,* and approaches that of the Horse.

Again, the skeleton of *Anchitherium* is extremely equine. M. Christol goes so far as to say that the description of the bones of the horse, or the ass, current in veterinary works, would fit those of *Anchitherium.* And, in a general way, this may be true enough; but there are some most important differences, which, indeed, are justly indicated by the same careful observer. Thus the ulna is complete throughout, and its shaft is not a mere rudiment, fused into one bone with the radius. There are three toes, one large in the middle and one small on each side. The femur is quite like that of a horse, and has the characteristic fossa above the external condyle. In the British Museum there is a most instructive specimen of the leg-bones, showing that the fibula was represented by the external malleolus and by a flat tongue of bone, which extends up from it on the outer side of the tibia, and is closely ankylosed with the latter bone.[3] The hind toes [357] are three, like those of the fore leg; and the middle metatarsal bone is much less compressed from side to side than that of the horse.

In the *Hipparion,* the teeth nearly resemble those of the Horses, though the crowns of the grinders are not so long; like those of the Horses, they are abundantly coated with cement. The shaft of the ulna is reduced to a mere style, ankylosed throughout nearly its whole length with the radius, and appearing to be little more than a ridge on the surface of the latter bone until it is carefully examined. The front toes are still three, but the outer ones are more slender than in *Anchitherium,* and their hoofs smaller in proportion to that of the middle toe; they are, in fact, reduced to mere dew-claws, and do not touch the ground. In the leg, the distal end of the fibula is so completely united with the tibia that it appears to be a mere process of the latter bone, as in the Horses.

In *Equus,* finally, the crowns of the grinding-teeth become longer, and their patterns are slightly modified; the middle of the shaft of the ulna usually vanishes, and its proximal and distal ends ankylose with the radius. The phalanges of the two outer toes in each foot disappear, their metacarpal and metatarsal bones being left as the "splints."

[358] The *Hipparion* has large depressions on the face in front of the orbits, like those for the "larmiers" of many ruminants; but traces of these are to be seen in some of the fossil horses from the Sewalik Hills; and, as Leidy's recent researches show, they are preserved in *Anchitherium.*

When we consider these facts, and the further circumstance that the Hipparions, the remains of which have been collected in immense numbers, were subject, as M. Gaudry and others have pointed out, to a great range of variation, it appears to me impossible to resist the conclusion that the types of the *Anchitherium,* of the *Hipparion,* and of the ancient Horses constitute the lineage of the modern Horses,

the *Hipparion* being the intermediate stage between the other two, and answering to B in my former illustration.

The process by which the *Anchitherium* has been converted into *Equus* is one of specialisation, or of more and more complete deviation from what might be called the average form of an ungulate mammal. In the Horses, the reduction of some parts of the limbs, together with the special modification of those which are left, is carried to a greater extent than in any other hoofed mammals. The reduction is less and the specialisation is less in the *Hipparion,* and still less in the *Anchitherium;* but yet, as compared with other mam[359]mals, the reduction and specialisation of parts in the *Anchitherium* remain great.

Is it not probable then, that, just as in the Miocene epoch, we find an ancestral equine form less modified than *Equus,* so, if we go back to the Eocene epoch, we shall find some quadruped related to the *Anchitherium* as *Hipparion* is related to *Equus,* and consequently departing less from the average form?

I think that this desideratum is very nearly, if not quite, supplied by *Plagiolophus,* remains of which occur abundantly in some parts of the Upper and Middle Eocene formations. The patterns of the grinding-teeth of *Plagiolophus* are similar to those of *Anchitherium,* and their crowns are as thinly covered with cement; but the grinders diminish in size forwards, and the last lower molar has a large hind lobe, convex outwards and concave inwards, as in *Palæotherium.* The ulna is complete and much larger than in any of the *Equus,* while it is more slender than in most of the true *Palæotheria;* it is fixedly united, but not ankylosed, with the radius. There are three toes in the fore limb, the outer ones being slender, but less attenuated than in the *Equus.* The femur is more like that of the *Palæotheria* than that of the horse, and has only a small depression above its outer condyle in the place of the great fossa which is so obvious in the *Equus.* The fibula is distinct, but very slender, and its distal end is [360] ankylosed with the tibia. There are three toes on the hind foot having similar proportions to those on the fore foot. The principal metacarpal and metatarsal bones are flatter than they are in any of the *Equus;* and the metacarpal bones are longer than the metatarsals, as in the *Palæotheria.*

In its general form, *Plagiolophus* resembles a very small and slender horse,[4] and is totally unlike the reluctant, pig-like creature depicted in Cuvier's restoration of his *Palæotherium minus* in the "Ossemens Fossiles."

It would be hazardous to say that *Plagiolophus* is the exact radical form of the Equine quadrupeds; but I do not think there can be any reasonable doubt that the latter animals have resulted from the modification of some quadruped similar to *Plagiolophus.*

We have thus arrived at the Middle Eocene formation, and yet have traced back the Horses only to a three-toed stock; but these three-toed forms, no less than the Equine quadrupeds themselves, present rudiments of the two other toes which appertain to what I have termed the "average" quadruped. If the expectation raised by the splints of the Horses that, in some ancestor of the Horses, these splints would be found to be complete digits, has been verified, we are fur[361]nished with very strong reasons for looking for a no less complete verification of the expectation that the three-toed *Plagiolophus*-like

"avus" of the horse must have had a five-toed "atavus" at some earlier period.

No such five-toed "atavus," however, has yet made its appearance among the few middle and older Eocene *Mammalia* which are known.

Another series of closely affiliated forms, though the evidence they afford is perhaps less complete than that of the Equine series, is presented to us by the *Dichobune* of the Eocene epoch, the *Cainotherium* of the Miocene, and the *Tragulidæ,* or so-called "Musk-deer," of the present day.

The *Tragulidæ* have no incisors in the upper jaw, and only six grinding-teeth on each side of each jaw; while the canine is moved up to the outer incisor, and there is a diastema in the lower jaw. There are four complete toes on the hind foot, but the middle metatarsals usually become, sooner or later, ankylosed into a cannon bone. The navicular and the cuboid unite, and the distal end of the fibula is ankylosed with the tibia.

In *Cainotherium,* and *Dichobune* the upper incisors are fully developed. There are seven grinders; the teeth form a continuous series without a diastema. The metatarsals, the navicular and cuboid, and the distal end of the fibula, remain free. In the *Cainotherium,* also, the second [362] metacarpal is developed, but is much shorter than the third, while the fifth is absent or rudimentary. In this respect it resembles *Anoplotherium secundarium.* This circumstance, and the peculiar pattern of the upper molars in *Cainotherium,* lead me to hesitate in considering it as the actual ancestor of the modern *Tragulidæ.* If *Dichobune* has a fore-toed fore foot (though I am inclined to suspect that it resembles *Cainotherium*), it will be a better representative of the oldest forms of the Traguline series; but *Dichobune* occurs in the Middle Eocene, and is, in fact, the oldest known artiodactyle mammal. Where, then, must we look for its five-toed ancestor?

If we follow down other lines of recent and tertiary *Ungulata,* the same question presents itself. The Pigs are traceable back through the Miocene epoch to the Upper Eocene, where they appear in the two well-marked forms of *Hyopopotamus* and *Chæropotamus;* but *Hyopotamus* appears to have had only two toes.

Again, all the great groups of the Ruminants, the *Bovidæ, Antilopidæ, Camelopardalidæ,* and *Corvidæ,* are represented in the Miocene epoch, and so are the Camels. The Upper Eocene *Anoplotherium,* which is intercalary between the Pigs and the *Tragulidæ,* has only two, or, at most, three toes. Among the scanty mammals of the Lower Eocene formation we have the perissodactyle *Ungulata* represented by *Coryphodon,* [363] *Hyracotherium,* and *Phiolophus.* Suppose for a moment, for the sake of following out the argument, that *Pliolophus* represents the primary stock of the Perissodactyles, and *Dichobune* that of the Artiodactyles (though I am far from saying that such is the case), then we find, in the earliest fauna of the Eocene epoch to which our investigations carry us, the two divisions of the *Ungulata* completely differentiated, and no trace of any common stock of both, or of five-toed predecessors to either. With the case of the Horses before us, justifying a belief in the production of new animal forms by modification of old ones, I see no escape from the necessity of seeking for these ancestors of the *Ungulata* beyond the limits of the Tertiary formations.

I could as soon admit special creation, at once, as suppose that the Perissodactyles and Artiodactyles had no five-toed ancestors. And when we consider how large a portion of the Tertiary period elapsed before *Anchitherium* was converted into *Equus,* it is difficult to escape the conclusion that a large proportion of time anterior to the Tertiary period must have been expended in converting the common stock of the *Ungulata* into Perissodactyles and Artiodactyles.

The same moral is inculcated by the study of every other order of Tertiary monodelphous *Mammalia.* Each of these orders is represented in the Miocene epoch: the Eocene formation, as [364] I have already said, contains *Cheiroptera, Insectivora, Rodentia, Ungulata*, *Carnivora,* and *Cetacea.* But the *Cheiroptera* are extreme modifications of the *Insectivora,* just as the *Cetacea* are extreme modifications of the Carnivorous type; and therefore it is to my mind incredible that monodelphous *Insectivora* and *Carnivora* should not have been abundantly developed, along with *Ungulata,* in the Mesozoic epoch. But if this be the case, how much further back must we go to find the common stock of the monodelphous *Mammalia*? As to the *Didelphia,* if we may trust the evidence which seems to be afforded by their very scanty remains, a Hypsiprymnoid form existed at the epoch of the Trias, contemporaneously with a Carnivorous form. At the epoch of the Trias, therefore, the *Marsupialia* must have already existed long enough to have become differentiated into carnivorous and herbivorous forms. But the *Monotremata* are lower forms than the *Didelphia* which last are intercalary between the *Ornithodelphia* and the *Monodelphia.* To what point of the Palæozoic epoch, then, must we, upon any rational estimate, relegate the origin of the *Monotremata*?

The investigation of the occurrence of the classes and of the orders of the *Sauropsida* in time points in exactly the same direction. If, as there is great reason to believe, true Birds existed in the Triassic epoch, the ornithoscelidous forms by [365] which Reptiles passed into Birds must have preceded them. In fact there is, even at present, considerable ground for suspecting the existence of *Dinosauria* in the Permian formations; but, in that case, lizards must be of still earlier date. And if the very small differences which are observable between the *Crocodilia* of the older Mesozoic formations and those of the present day furnish any sort of approximation towards an estimate of the average rate of change among the *Sauropsida,* it is almost appalling to reflect how far back in Palæozoic times we must go, before we can hope to arrive at that common stock from which the *Crocodilia, Lacertilia, Ornithoscelida,* and *Plesiosauria,* which had attained so great a development in the Triassic epoch, must have been derived.

The *Amphibia* and*Pisces* tell the same story. There is not a single class of vertebrated animals which, when it first appears, is represented by analogues of the lowest known members of the same class. Therefore, if there is any truth in the doctrine of evolution, every class must be vastly older than the first record of its appearance upon the surface of the globe. But if considerations of this kind compel us to place the origin of vertebrated animals at a period sufficiently distant from the Upper Silurian, in which the first Elasmobranchs and Ganoids occur, to allow of the evolution of such fishes as these from a Vertebrate [366] as simple as the *Amphioxus,* I can only repeat that it is appalling to speculate upon the extent to which that origin must have preceded the epoch of the first recorded appearance of vertebrate life.

Such is the further commentary which I have to offer upon the statement of the chief results of palæontology which I formerly ventured to lay before you.

But the growth of knowledge in the interval makes me conscious of an omission of considerable moment in that statement, inasmuch as it contains no reference to the bearings of palæontology upon the theory of the distribution of life; nor takes note of the remarkable manner in which the facts of distribution, in present and past times, accord with the doctrine of evolution, especially in regard to land animals.

That connection between palæontology and geology and the present distribution of terrestrial animals, which so strikingly impressed Mr. Darwin, thirty years ago, as to lead him to speak of a "law of succession of types," and of the wonderful relationship on the same continent between the dead and the living, has recently received much elucidation from the researches of Gaudry, of Rutimeyer, of Leidy, and of Alphonse Milne-Edwards, taken in connection with the earlier labours of our lamented colleague Falconer; and [367] it has been instructively discussed in the thoughtful and ingenious work of Mr. Andrew Murray "On the Geographical Distribution of Mammals."[5]

I propose to lay before you, as briefly as I can, the ideas to which a long consideration of the subject has given rise in my mind.

If the doctrine of evolution is sound, one of its immediate consequences clearly is, that the present distribution of life upon the globe is the product of two factors, the one being the distribution which obtained in the immediately preceding epoch, and the other the character and the extent of the changes which have taken place in physical geography between the one epoch and the other; or, to put the matter in another way, the Fauna and Flora of any given area, in any given epoch, can consist only of such forms of life as are directly descended from those which constituted the Fauna and Flora of the same area in the immediately preceding epoch, unless the physical geography (under which I include climatal conditions) of the area has been so altered as to give rise to immigration of living forms from some other area.

The evolutionist, therefore, is bound to grapple [368] with the following problem whenever it is clearly put before him:–Here are the Faunæ of the same area during successive epochs. Show good cause for believing either that these Faunæ have been derived from one another by gradual modification, or that the Faunæ have reached the area in question by migration from some area in which they have undergone their development.

I propose to attempt to deal with this problem, so far as it is exemplified by the distribution of the terrestrial *Vertebrata,* and I shall endeavour to show you that it is capable of solution in a sense entirely favourable to the doctrine of evolution.

I have elsewhere[6] stated at length the reasons which lead me to recognise four primary distributional provinces for the terrestrial *Vertebrata* in the present world, namely,–first, the *Novozelanian,* or New-

Zealand province; secondly, the *Australian* province, including Australia, Tasmania, and the Negrito Islands; thirdly, *Austro-Columbia*, or South America *plus* North America as far as Mexico; and fourthly, the rest of the world, or *Arctogæa*, in which province America north of Mexico constitutes one sub-province, Africa south of the Sahara a second, Hindostan a third, and the remainder of the Old World a fourth.

Now the truth which Mr. Darwin perceived and [369] promulgated as "the law of the succession of types" is, that, in all these provinces, the animals found in Pliocene or later deposits are closely affined to those which now inhabit the same provinces; and that, conversely, the forms characteristic of other provinces are absent. North and South America, perhaps, present one or two exceptions to the last rule, but they are readily susceptible of explanation. Thus, in Australia, the later Tertiary mammals are marsupials (possibly with the exception of the Dog and a Rodent or two, as at present). In Austro-Columbia, the later Tertiary fauna exhibits numerous and varied forms of Platyrrhine Apes, Rodents, Cats, Dogs, Stags, *Edentata*, and Opossums; but, as at present, no Catarrhine Apes, no Lemurs, no *Insectivora*, Oxen, Antelopes, Rhinoceroses, nor *Didelphia* other than Opossums. And in the widespread Arctogæal province, the Pliocene and later mammals belong to the same groups as those which now exist in the province. The law of succession of types, therefore, holds good for the present epoch as compared with its predecessor. Does it equally well apply to the Pliocene fauna when we compare it with that of the Miocene epoch? By great good fortune, an extensive mammalian fauna of the latter epoch has now become known, in four very distant portions of the Arctogæal province which do not differ greatly in latitude. Thus Falconer and Gautley have made known [370] the fauna of the sub-Himalayas and the Perim Islands; Gaudry that of Attica; many observers that of Central Europe and France; and Leidy that of Nebraska, on the eastern flank of the Rocky Mountains. The results are very striking. The total Miocene fauna comprises many genera and species of Catarrhine Apes, of Bats, of *Insectivora;* of Arctogæal types of *Rodentia;* of *Proboscidea;* of equine, rhinocerotic, and tapirine quadrupeds; of cameline, bovine, antilopine, cervine, and traguline Ruminants; of Pigs and Hippopotamuses; of *Viverridæ* and *Hyænidæ* among other *Carnivora;* with *Edentata* allied to the Arctogæal *Orycteropus* and *Manis*, and not to the Austro-Columbian Edentates. The only type present in the Miocene, but absent in the existing, fauna of Eastern Arctogæa, is that of the *Didelphidæ*, which, however, remains in North America.

But it is very remarkable that while the Miocene fauna of the Arctogæal province, as a whole, is of the same character as the existing fauna of the same province, as a whole, the component elements of the fauna were differently associated. In the Miocene epoch, North America possessed Elephants, Horses, Rhinoceroses, and a great number and variety of Ruminants and Pigs, which are absent in the present indigenous fauna; Europe had its Apes, Elephants, Rhinoceroses, Tapirs, Musk-deer, Giraffes, Hyænas, great Cats, Edentates, and Opossum-like Marsupials, which [371] have equally vanished from its present fauna; and in Northern India, the African types of Hippopotamuses, Giraffes, and Elephants were mixed up with what are now the Asiatic types of the latter, and with Camels, and Semnopithecine and Pithecine Apes of no less distinctly Asiatic forms.

In fact the Miocene mammalian fauna of Europe and the Himalayan regions contains, associated together, the types which are at present separately located in the South-African and Indian sub-provinces

of Arctogæa. Now there is every reason to believe, on other grounds, that both Hindostan, south of the Ganges, and Africa, south of the Sahara, were separated by a wide sea from Europe and North Asia during the Middle and Upper Eocene epochs. Hence it becomes highly probable that the well-known similarities, and no less remarkable differences between the present Faunæ of India and South Africa have arisen in some such fashion as the following. Some time during the Miocene epoch, possibly when the Himalayan chain was elevated, the bottom of the nummulitic sea was upheaved and converted into dry land, in the direction of a line extending from Abyssinia to the mouth of the Ganges. By this means, the Dekhan on the one hand, and South Africa on the other, became connected with the Miocene dry land and with one another. The Miocene mammals spread gradually over this intermediate [372] dry land; and if the condition of its eastern and western ends offered as wide contrasts as the valleys of the Ganges and Arabia do now, many forms which made their way into Africa must have been different from those which reached the Dekhan, while others might pass into both these sub-provinces.

That there was a continuity of dry land between Europe and North America during the Miocene epoch, appears to me to be a necessary consequence of the fact that many genera of terrestrial mammals, such as *Castor, Hystrix, Elephas, Mastodon, Equus, Hipparion, Anchitherium, Rhinoceros, Cervus, Amphicyon, Hyænarctos,* and *Machairodus,* are common to the Miocene formations of the two areas, and have as yet been found (except perhaps *Anchitherium*) in no deposit of earlier age. Whether this connection took place by the east, or by the west, or by both sides of the Old World, there is at present no certain evidence, and the question is immaterial to the present argument; but, as there are good grounds for the belief that the Australian province and the Indian and South-African sub-provinces were separated by sea from the rest of Arctogæa before the Miocene epoch, so it has been rendered no less probable, by the investigations of Mr. Carrick Moore and Professor Duncan, that Austro-Columbia was separated by sea from North America during a large part of the Miocene epoch.

[373] It is unfortunate that we have no knowledge of the Miocene mammalian fauna of the Australian and Austro-Columbian provinces; but, seeing that not a trace of a Platyrrhine Ape, of a Procyonine Carnivore, of a characteristically South-American Rodent, of a Sloth, an Armadillo, or an Ant-eater has yet been found in Miocene deposits of Arctogæa, I cannot doubt that they already existed in the Miocene Austro-Columbian province.

Nor is it less probable that the characteristic types of Australian Mammalia were already developed in that region in Miocene times.

But Austro-Columbia presents difficulties from which Australia is free; *Camelidæ* and *Tapiridæ* are now indigenous in South America as they are in Arctogæa; and, among the Pliocene Austro-Columbian mammals, the Arctogæal genera *Equus, Mastodon,* and *Machairodus* are numbered. Are these Postmiocene immigrants, or Præmiocene natives?

Still more perplexing are the strange and interesting forms *Toxodon, Macrauchenia, Typotherium,* and a new Anoplotherioid mammal (*Homalodotherium*) which Dr. Cunningham sent over to me some time ago from Patagonia. I confess I am strongly inclined to surmise that these last, at any rate, are remnants

of the population of Austro-Columbia before the Miocene epoch, and were not derived from Arctogæa by way of the north and east.

[374] The fact that this immense fauna of Miocene Arctogæa is now fully and richly represented only in India and in South Africa, while it is shrunk and depauperised in North Asia, Europe, and North America, becomes at once intelligible, if we suppose that India and South Africa had but a scanty mammalian population before the Miocene immigration, while the conditions were highly favourable to the new comers. It is to be supposed that these new regions offered themselves to the Miocene Ungulates, as South America and Australia offered themselves to the cattle, sheep, and horses of modern colonists. But, after these great areas were thus peopled, came the Galacial epoch, during which the excessive cold, to say nothing of depression and ice-covering, must have almost depopulated all the northern parts of Arctogæa, destroying all the higher mammalian forms, except those which, like the Elephant and Rhinoceros, could adjust their coats to the altered conditions. Even these must have been driven away from the greater part of the area; only those Miocene mammals which had passed into Hindostan and into South Africa would escape decimation by such changes in the physical geography of Arctogæa. And when the northern hemisphere passed into its present condition, these lost tribes of the Miocene Fauna were hemmed by the Himalayas, the Sahara, the Red Sea, and the Arabian deserts, within their present boundaries.

[375] Now, on the hypothesis of evolution, there is no sort of difficulty in admitting that the differences between the Miocene forms of the mammalian Fauna and those which exist at present are the results of gradual modification; and, since such differences in distribution as obtain are readily explained by the changes which have taken place in the physical geography of the world since the Miocene epoch, it is clear that the result of the comparison of the Miocene and present Faunæ is distinctly in favour of evolution. Indeed I may go further. I may say that the hypothesis of evolution explains the facts of Miocene, Pliocene, and Recent distribution, and that no other supposition even pretends to account for them. It is, indeed, a conceivable supposition that every species of Rhinoceros and every species of Hyæna, in the long succession of forms between the Miocene and the present species, was separately constructed out of dust, or out of nothing, by supernatural power; but until I receive distinct evidence of the fact, I refuse to run the risk of insulting any sane man by supposing that he seriously holds such a notion.

Let us now take a step further back in time, and inquire into the relations between the Miocene Fauna and its predecessor of the Upper Eocene formation.

Here it is to be regretted that our materials for forming a judgment are nothing to be compared [376] in point of extent or variety with those which are yielded by the Miocene strata. However, what we do know of this Upper Eocene Fauna of Europe gives sufficient positive information to enable us to draw some tolerably safe inferences. It has yielded representatives of *Insectivora,* of *Cheiroptera,* of *Rodentia,* of *Carnivora,* of artiodactyle and perissodactyle *Ungulata,* and of opossum-like Marsupials. No Australian type of Marsupial has been discovered in the Upper Eocene strata, nor any Edentate mammal. The genera (except perhaps in the case of some of the *Insectivora, Cheiroptera,* and *Rodentia*) are different from those of the Miocene epoch, but present a remarkable general similarity to the Miocene

and recent genera. In several cases, as I have already shown, it has now been clearly made out that the relation between the Eocene and Miocene forms is such that the Eocene form is the less specialised; while its Miocene ally is more so, and the specialisation reaches its maximum in the recent forms of the same type.

So far as the Upper Eocene and the Miocene Mammalian Faunæ are comparable, their relations are such as in no way to oppose the hypothesis that the older are the progenitors of the more recent forms, while, in some cases, they distinctly favour that hypothesis. The period in time and the changes in physical geography represented by the nummulitic deposits are undoubtedly very [377] great, while the remains of Middle Eocene and Older Eocene Mammals are comparatively few. The general facies of the Middle Eocene Fauna, however, is quite that of the Upper. The Older Eocene pre-nummulitic mammalian Fauna contains Bats, two genera of *Carnivora,* three genera of *Ungulata* (probably all perissodactyle), and a didelphid Marsupial; all these forms, except perhaps the Bat and the Opossum, belong to genera which are not known to occur out of the Lower Eocene formation. The *Coryphodon* appears to have been allied to the Miocene and later Tapirs, while *Pliolophus,* in its skull and dentition, curiously partakes of both artiodactyle and perissodactyle characters; the third trochanter upon its femur, and its three-toed hind foot, however, appear definitely to fix its position in the latter division.

There is nothing, then, in what is known of the older Eocene mammals of the Arctogæal province to forbid the supposition that they stood in an ancestral relation to those of the Calcaire Grossier and the Gypsum of the Paris basin, and that our present fauna, therefore, is directly derived from that which already existed in Arctogæa at the commencement of the Tertiary period. But if we now cross the frontier between the Cainozoic and the Mesozoic faunæ, as they are preserved within the Arctogæal area, we meet with an astounding change, and what appears to be a [378] complete and unmistakable break in the line of biological continuity.

Among the twelve or fourteen species of *Mammalia* which are said to have been found in the Purbecks, not one is a member of the orders *Cheiroptera, Rodentia, Ungu1ata,* or *Carnivora,* which are so well represented in the Tertiaries. No *Insectivora* are certainly known, nor any opossum-like Marsupials. Thus there is a vast negative difference between the Cainozoic and the Mesozoic mammalian faunæ of Europe. But there is a still more important positive difference, inasmuch as all these Mammalia appear to be Marsupials belonging to Australian groups, and thus appertaining to a different distributional province from the Eocene and Miocene marsupials, which are Austro-Columbian. So far as the imperfect materials which exist enable a judgment to be formed, the same law appears to have held good for all the earlier Mesozoic *Mammalia.* Of the Stonesfield slate mammals, one, *Amphitherium,* has a definitely Australian character; one, *Phascolotherium,* may be either Dasyurid or Didelphine; of a third, *Stereognathus,* nothing can at present be said. The two mammals of the Trias, also, appear to belong to Australian groups.

Every one is aware of the many curious points of resemblance between the marine fauna of the European Mesozoic rocks and that which now [379] exists in Australia. But if there was this Australian facies about both the terrestrial and the marine faunæ of Mesozoic Europe, and if there is this unaccountable and immense break between the fauna of Mesozoic and that of Tertiary Europe, is it not a

very obvious suggestion that, in the Mesozoic epoch, the Australian province included Europe, and that the Arctogæal province was contained within other limits The Arctogæal province is at present enormous, while the Australian is relatively small. Why should not these proportions have been different during the Mesozoic epoch?

Thus I am led to think that by far the simplest and most rational mode of accounting for the great change which took place in the living inhabitants of the European area at the end of the Mesozoic epoch, is the supposition that it arose from a vast alteration of the physical geography of the globe; whereby an area long tenanted by Cainozoic forms was brought into such relations with the European area that migration from the one to the other became possible, and took place on a great scale.

This supposition relieves us, at once, from the difficulty in which we were left, some time ago, by the arguments which I used to demonstrate the necessity of the existence of all the great types of the Eocene epoch in some antecedent period.

[380] It is this Mesozoic continent (which may well have lain in the neighbourhood of what are now the shores of the North Pacific Ocean) which I suppose to have been occupied by the Mesozoic *Monodelphia;* and it is in this region that I conceive they must have gone through the long series of changes by which they were specialised into the forms which we refer to different orders. I think it very probable that what is now South America may have received the characteristic elements of its mammalian fauna during the Mesozoic epoch; and there can be little doubt that the general nature of the change which took place at the end of the Mesozoic epoch in Europe was the upheaval of the eastern and northern regions of the Mesozoic sea-bottom into a westward extension of the Mesozoic continent, over which the mammalian fauna, by which it was already peopled, gradually spread. This invasion of the land was prefaced by a previous invasion of the Cretaceous sea by modern forms of mollusca and fish.

It is easy to imagine how an analogous change might come about in the existing world. There is, at present, a great difference between the fauna of the Polynesian Islands and that of the west coast of America. The animals which are leaving their spoils in the deposits now forming in these localities are widely different. Hence, if a gradual shifting of the deep sea, which at present bars [381] migration between the easternmost of these islands and America, took place to the westward, while the American side of the sea-bottom was gradually upheaved, the palæontologist of the future would find, over the Pacific area, exactly such a change as I am supposing to have occurred in the North Atlantic area at the close of the Mesozoic period. An Australian fauna would be found underlying an American fauna, and the transition from the one to the other would be as abrupt as that between the Chalk and lower Tertiaries; and as the drainage-area of the newly formed extension of the American continent gave rise to rivers and lakes, the mammals mired in their mud would differ from those of like deposits on the Australian side, just as the Eocene mammals differ from those of the Purbecks.

How do similar reasonings apply to the other great change of life–that which took place at the end of the Palæozoic period?

In the Triassic epoch, the distribution of the dry land and of terrestrial vertebrate life appears to have been, generally, similar to that which existed in the Mesozoic epoch; so that the Triassic continents and their faunæ seem to be related to the Mesozoic lands and their faunæ, just as those of the Miocene epoch are related to those of the present day. In fact, as I have recently endeavoured to prove to the Society, there was an Arctogæal continent and an Arctogæal province of distribution in Triassic times as there is now; and the *Saurop*[382]*sida* and *Marsupialia* which constituted that fauna were, I doubt not, the progenitors of the *Sauropsida* and *Marsupialia* of the whole Mesozoic epoch.

Looking at the present terrestrial fauna of Australia, it appears to me to be very probable that it is essentially a remnant of the fauna of the Triassic, or even of an earlier, age;[7] in which case Australia must at that time have been in continuity with the Arctogæal continent.

But now comes the further inquiry, Where was the highly differentiated Sauropsidan fauna of the Trias in Palæozoic times? The supposition that the Dinosaurian, Crocodilian, Dicynodontian, and Plesiosaurian types were suddenly created at the end of the Permian epoch may be dismissed, without further consideration, as a monstrous and unwarranted assumption. The supposition that all these types were rapidly differentiated out of *Lacertilia* in the time represented by the passage from the Palæozoic to the Mesozoic formation, appears to me to be hardly more credible, to say nothing of the indications of the existence of Dinosaurian forms in the Permian rocks which have already been obtained.

For my part, I entertain no sort of doubt that the Reptiles, Birds, and Mammals of the Trias are the direct descendants of Reptiles, Birds, and Mammals which existed in the latter part of the [383] Palæozoic epoch, but not in any area of the present dry land which has yet been explored by the geologist.

This may seem a bold assumption, but it will not appear unwarrantable to those who reflect upon the very small extent of the earth's surface which has hitherto exhibited the remains of the great Mammalian fauna of the Eocene times. In this respect, the Permian land Vertebrate fauna appears to me to be related to the Triassic much as the Eocene is to the Miocene. Terrestrial reptiles have been found in Permian rocks only in three localities; in some spots of France, and recently of England, and over a more extensive area in Germany. Who can suppose that the few fossils yet found in these regions give any sufficient representation of the Permian fauna?

It may be said that the Carboniferous formations demonstrate the existence of a vast extent of dry land in the present dry-land area, and that the supposed terrestrial Palæozoic Vertebrate Fauna ought to have left its remains in the Coal-measures, especially as there is now reason to believe that much of the coal was formed by the accumulation of spores and sporangia on dry land. But if we consider the matter more closely, I think that this apparent objection loses its force. It is clear that, during the Carboniferous epoch, the vast area of land which is now covered by Coal-measures must have been undergoing a gradual depression. The dry land thus depressed [384] must, therefore, have existed, as such, before the Carboniferous epoch–in other words, in Devonian times–and its terrestrial population may never have been other than such as existed during the Devonian, or some previous epoch, although much higher forms may have been developed elsewhere.

Again, let me say that I am making no gratuitous assumption of inconceivable changes. It is clear that the enormous area of Polynesia is, on the whole, an area over which depression has taken place to an immense extent; consequently a great continent, or assemblage of subcontinental masses of land must have existed at some former time, and that at a recent period, geologically speaking, in the area of the Pacific. But if that continent had contained Mammals, some of them must have remained to tell the tale; and as it is well known that these islands have no indigenous *Mammalia*, it is safe to assume that none existed. Thus, midway between Australia and South America, each of which possesses an abundant and diversified mammalian fauna, a mass of land, which may have been as large as both put together, must have existed without a mammalian inhabitant. Suppose that the shores of this great land were fringed, as those of tropical Australia are now, with belts of mangroves, which would extend landwards on the one side, and be buried beneath littoral deposits on the other side, as depression went on; and great beds of mangrove lignite [385] might accumulate over the sinking land. Let upheaval of the whole now take place, in such a manner as to bring the emerging land into continuity with the South-American or Australian continent, and, in course of time, it would be peopled by an extension of the fauna of one of these two regions–just as I imagine the European Permian dry land to have been peopled.

I see nothing whatever against the supposition that distributional provinces of terrestrial life existed in the Devonian epoch, inasmuch as M. Barrande has proved that they existed much earlier. I am aware of no reason for doubting that, as regards the grades of terrestrial life contained in them, one of these may have been related to another as New Zealand is to Australia, or as Australia is to India, at the present day. Analogy seems to me to be rather in favour of, than against, the supposition that while only Ganoid fishes inhabited the fresh waters of our Devonian land, *Amphibia* and *Reptilia*, or even higher forms, may have existed, though we have not yet found them. The earliest Carboniferous *Amphibia* now known, such as *Anthracosaurus* are so highly specialised that I can by no means conceive that they have been developed out of piscine forms in the interval between the Devonian and the Carboniferous periods, considerable as that is. And I take refuge in one of two alternatives: either they existed in our own area during the Devonian epoch and we have simply not yet found [386] them; or they formed part of the population of some other distributional province of that day, and only entered our area by migration at the end of the Devonian epoch. Whether *Reptilia* and *Mammalia* existed along with them is to me, at present, a perfectly open question, which is just as likely to receive an affirmative as a negative answer from future inquirers.

Let me now gather together the threads of my argumentation into the form of a connected hypothetical view of the manner in which the distribution of living and extinct animals has been brought about.

I conceive that distinct provinces of the distribution of terrestrial life have existed since the earliest period at which that life is recorded, and possibly much earlier; and I suppose, with Mr. Darwin, that the progress of modification of terrestrial forms is more rapid in areas of elevation than in areas of depression. I take it to be certain that Labyrinthodont *Amphibia* existed in the distributional province which included the dry land depressed during the Carboniferous epoch; and I conceive that, in some other distributional provinces of that day, which remained in the condition of stationary or of increasing dry land, the various types of the terrestrial *Sauropsida* and of the *Mammalia* were gradually developing.

The Permian epoch marks the commencement of a new movement of upheaval in our area, which attained its maximum in the Triassic epoch, when [387] dry land existed in North America, Europe, Asia, and Africa, as it does now. Into this great new continental area the Mammals, Birds, and Reptiles developed during the Palæozoic epoch spread, and formed the great Triassic Arctogæal province. But, at the end of the Triassic period, the movement of depression recommenced in our area, though it was doubtless balanced by elevation elsewhere; modification and development, checked in the one province, went on in that "elsewhere"; and the chief forms of Mammals, Birds and Reptiles, as we know them, were evolved and peopled the Mesozoic continent. I conceive Australia to have become separated from the continent as early as the end of the Triassic epoch, or not much later. The Mesozoic continent must, I conceive, have lain to the east, about the shores of the North Pacific and Indian Oceans; and I am inclined to believe that it continued along the eastern side of the Pacific area to what is now the province of Austro-Columbia, the characteristic fauna of which is probably a remnant of the population of the latter part of this period.

Towards the latter part of the Mesozoic period the movement of upheaval around the shores of the Atlantic once more recommenced, and was very probably accompanied by a depression around those of the Pacific. The Vertebrate fauna elaborated in the Mesozoic continent moved westward and took possession of the new lands, which gradually increased in extent up to, and in some directions after, the Miocene epoch.

It is in favour of this hypothesis, I think, that it is consistent with the persistence of a general uniformity in the positions of the great masses of land and water. From the Devonian period, or earlier, to the present day, the four great oceans, Atlantic, Pacific, Arctic, and Antarctic, may have occupied their present positions, and only their coasts and channels of communication have undergone an incessant alteration. And, finally, the hypothesis I have put before you requires no supposition that the rate of change in organic life has been either greater or less in ancient times than it is now; nor any assumption, either physical or biological, which has not its justification in analogous phenomena of existing nature.

I have now only to discharge the last duty of my office, which is to thank you, not only for the patient attention with which you have listened to me so long to-day, but also for the uniform kindness with which, for the past two years, you have rendered my endeavours to perform the important, and often laborious, functions of your President a pleasure instead of a burden.

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[1] See an article in the *Saturday Review*, for 1858, on "Chalk, Ancient and Modern."

[2] Hermann von Meyer gave the name of *Anchitherium* to *A. Ezquerræ;* and in his paper on the subject he takes great pains to distinguish the latter as the type of a new genus, from Cuvier's *Palæotherium d'Orléans.* But it is precisely the *Palæotherium d'Orléans* which is the type of Christol's genus *Hipparitherium;* and thus, though *Hipparitherium* is of later date than *Anchitherium*, it seemed to me to have a sort of equitable right to recognition when this Address was written. On the whole, however, it seems most convenient to adopt *Anchitherium.*

[3] I am indebted to M. Gervais for a specimen which indicates that the fibula was complete, at any rate, in some cases; and for a very interesting ramus of a mandible, which shows that, as in the *Palæotheria,* the hindermost milli-molar of the lower jaw was devoid of the posterior lobe which exists in the hindermost true molar.

[4] Such, at least, is the conclusion suggested by the proportions of the skeleton figured by Cuvier and De Blainville; but perhaps something between a Horse and an Agouti would be nearest the mark.

[5] The paper "On the Form and Distribution of the Land-tracts during the Secondary and Tertiary Periods respectively; and on the Effect upon Animal Life which great Changes in Geographical Configuration have probably produced," by Mr. Searles V. Wood. ,jun., which was published in the *Philosophical Magazine,* in 1862, was unknown to me when this Address was written. It is well worthy of the most careful study.

[6] "On the Classification and Distribution of the Alectoromorphæ;" *Proceedings of the Zoological Society,* 1868.

[7] Since this Address was read, Mr. Krefft has sent us news of the discovery in Australia of a freshwater fish of strangely Palæozoic aspect, and apparently a Ganoid intermediate between *Dipterus* and *Lepidosiren.* [The now well-known *Ceratodus.* 1894.]

"Professor Huxley, F. R. S".

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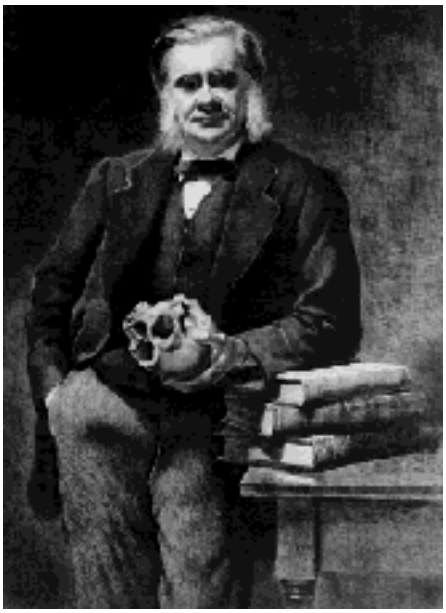

Preface and Table of Contents to Volume VII, *Discourses: Biological & Geological,* of Huxley's *Collected Essays.*

Previous article: Geological Reform [1869], pages 305-339.

Preface and Table of Contents to the next volume, Volume IX of Huxley's *Collected Essays.*

C. Blinderman & D. Joyce
Clark University

Evolution and Ethics - Prolegomena (1894)

Collected Essays IX

I.

[1] IT may be safely assumed that, two thousand years ago, before Cæsar set foot in southern Britain, the whole country-side visible from the windows of the room in which I write, was in what is called "the state of nature." Except, it may be, by raising a few sepulchral mounds, such as those which still, here and there, break the flowing contours of the downs, man's hands had made no mark upon it; and the thin veil of vegetation which overspread the broad-backed heights and the shelving sides of the coombs was unaffected by his industry. The native grasses and weeds, the scattered patches of gorse, contended with one another for the possession of the scanty surface soil; they fought against the droughts of summer, [2] the frosts of winter, and the furious gales which swept, with unbroken force, now from the Atlantic, and now from the North Sea, at all times of the year; they filled up, as they best might, the gaps made in their ranks by all sorts of underground and overground animal ravagers. One year with another, an average population, the floating balance of the unceasing struggle for existence among the indigenous plants, maintained itself. It is as little to be doubted, that an essentially similar state of nature prevailed, in this region, for many thousand years before the coming of Cæsar; and there is no assignable reason for denying that it might continue to exist through an equally prolonged futurity, except for the intervention of man.

Reckoned by our customary standards of duration, the native vegetation, like the "everlasting hills" which it clothes, seems a type of permanence. The little Amarella Gentians, which abound in some places to-day, are the descendants of those that were trodden underfoot by the prehistoric savages who have left their flint tools about, here and there; and they followed ancestors which, in the climate of the glacial epoch, probably flourished better than they do now. Compared with the long past of this humble plant, all the history of civilized men is but an episode.

Yet nothing is more certain than that, measured by the liberal scale of time-keeping of the universe, this present state of nature, however it may seem [3] to have gone and to go on for ever, is but a fleeting phase of her infinite variety; merely the last of the series of changes which the earth's surface has undergone in the course of the millions of years of its existence. Turn back a square foot of the thin turf, and the solid foundation of the land, exposed in cliffs of chalk five hundred feet high on the adjacent shore, yields full assurance of a time when the sea covered the site of the "everlasting hills"; and when the vegetation of what land lay nearest, was as different from the present Flora of the Sussex downs, as that of Central Africa now is.[1] No less certain is it that, between the time during which the chalk was formed and that at which the original turf came into existence, thousands of centuries elapsed, in the course of which, the state of nature of the ages during which the chalk was deposited, passed into that which now is, by changes so slow that, in the coming and going of the generations of men, had such witnessed them, the contemporary conditions would have seemed to be unchanging and unchangeable.

But it is also certain that, before the deposition of the chalk, a vastly longer period had elapsed, throughout which it is easy to follow the traces of the same process of ceaseless modification and of the internecine struggle for existence of living things; and that even when we can get no further [4] back, it is not because there is any reason to think we have reached the beginning, but because the trail of the most ancient life remains hidden, or has become obliterated.

Thus that state of nature of the world of plants, which we began by considering, is far from possessing the attribute of permanence. Rather its very essence is impermanence. It may have lasted twenty or thirty thousand years, it may last for twenty or thirty thousand years more, without obvious change; but, as surely as it has followed upon a very different state, so it will be followed by an equally different condition. That which endures is not one or another association of living forms, but the process of which the cosmos is the product, and of which these are among the transitory expressions. And in the living world, one of the most characteristic features of this cosmic process is the struggle for existence, the competition of each with all, the result of which is the selection, that is to say, the survival of those forms which, on the whole, are best adapted to the conditions which at any period obtain; and which are, therefore, in that respect, and only in that respect, the fittest.[2] The acme reached by the cosmic process [5] in the vegetation of the downs is seen in the turf, with its weeds and gorse. Under the conditions, they have come out of the struggle victorious; and, by surviving, have proved that they are the fittest to survive.

That the state of nature, at any time, is a temporary phase of a process of incessant change, which has been going on for innumerable ages, appears to me to be a proposition as well established as any in modern history. Paleontology assures us, in addition, that the ancient philosophers who, with less reason, held the same doctrine, erred in supposing that the phases formed a cycle, exactly repeating the past, exactly foreshadowing the future, in their rotations. On the contrary, it furnishes us with conclusive reasons for thinking that, if every link in the ancestry of these humble indigenous plants had been preserved and were accessible to us, the whole would present a converging series of forms of gradually diminishing complexity, until, at some period in the history of the earth, far more remote than any of which organic remains have yet been discovered, they would merge in those low groups among which the boundaries between animal and vegetable life become effaced.[3]

[6] The word "evolution," now generally applied to the cosmic process, has had a singular history, and is used in various senses.[4] Taken in its popular signification it means progressive development, that is, gradual change from a condition of relative uniformity to one of relative complexity; but its connotation has been widened to include the phenomena of retrogressive metamorphosis, that is, of progress from a condition of relative complexity to one of relative uniformity.

As a natural process, of the same character as the development of a tree from its seed, or of a fowl from its egg, evolution excludes creation and all other kinds of supernatural intervention. As the expression of a fixed order, every stage of which is the effect of causes operating according to definite rules, the conception of evolution no less excludes that of chance. It is very desirable to remember that evolution

is not an explanation of the cosmic process, but merely a generalized statement of the method and results of that process. And, further, that, if there is proof that the cosmic process was set going by any agent, then that agent will be the creator of it and of all its products, although supernatural intervention may remain strictly excluded from its further course.

So far as that limited revelation of the nature of things, which we call scientific knowledge, has [7] yet gone, it tends, with constantly increasing emphasis, to the belief that, not merely the world of plants, but that of animals; not merely living things, but the whole fabric of the earth; not merely our planet, but the whole solar system; not merely our star and its satellites, but the millions of similar bodies which bear witness to the order which pervades boundless space, and has endured through boundless time; are all working out their predestined courses of evolution.

With none of these have I anything to do, at present, except with that exhibited by the forms of life which tenant the earth. All plants and animals exhibit the tendency to vary, the causes of which have yet to be ascertained; it is the tendency of the conditions of life, at any given time, while favouring the existence of the variations best adapted to them, to oppose that of the rest and thus to exercise selection; and all living things tend to multiply without limit, while the means of support are limited; the obvious cause of which is the production of offspring more numerous than their progenitors, but with equal expectation of life in the actuarial sense. Without the first tendency there could be no evolution. Without the second, there would be no good reason why one variation should disappear and another take its place; that is to say, there would be no selection. Without the [8] third, the struggle for existence, the agent of the selective process in the state of nature, would vanish.[5]

Granting the existence of these tendencies, all the known facts of the history of plants and of animals may be brought into rational correlation. And this is more than can be said for any other hypothesis that I know of. Such hypotheses, for example, as that of the existence of a primitive, orderless chaos; of a passive and sluggish eternal matter moulded, with but partial success, by archetypal ideas; of a brand-new world-stuff suddenly created and swiftly shaped by a super-natural power; receive no encouragement, but the contrary, from our present knowledge. That our earth may once have formed part of a nebulous cosmic magma is certainly possible, indeed seems highly probable; but there is no reason to doubt that order reigned there, as completely as amidst what we regard as the most finished works of nature or of man.[6]

The faith which is born of knowledge, finds its object in an external order, bringing forth ceaseless change, through endless time, in endless space; the manifestations of the cosmic energy alternating between phases of potentiality and phases of explication. It may be that, as Kant suggests,[7] every cosmic [9] magma predestined to evolve into a new world, has been the no less predestined end of a vanished predecessor.

II

Three or four years have elapsed since the state of nature, to which I have referred, was brought to an end, so far as a small patch of the soil is concerned, by the intervention of man. The patch was cut off from the rest by a wall; within the area thus protected, the native vegetation was, as far as possible, extirpated; while a colony of strange plants was imported and set down in its place. In short, it was made into a garden. At the present time, this artificially treated area presents an aspect extraordinarily different from that of so much of the land as remains in the state of nature, outside the wall. Trees, shrubs, and herbs, many of them appertaining to the state of nature of remote parts of the globe, abound and flourish. Moreover, considerable quantities of vegetables, fruits, and flowers are produced, of kinds which neither now exist, nor have ever existed, except under conditions such as obtain in the garden; and which, therefore, are as much works of the art of man as the frames and glass-houses in which some of them are raised. That the "state of Art," thus created in the state of nature by man, is sustained by and dependent on him, would at once become [10] apparent, if the watchful supervision of the gardener were withdrawn, and the antagonistic influences of the general cosmic process were no longer sedulously warded off, or counteracted. The walls and gates would decay; quadrupedal and bipedal intruders would devour and tread down the useful and beautiful plants; birds, insects, blight, and mildew would work their will; the seeds of the native plants, carried by winds or other agencies, would immigrate, and in virtue of their long-earned special adaptation to the local conditions, these despised native weeds would soon choke their choice exotic rivals. A century or two hence, little beyond the foundations of the wall and of the houses and frames would be left, in evidence of the victory of the cosmic powers at work in the state of nature, over the temporary obstacles to their supremacy, set up by the art of the horticulturist.

It will be admitted that the garden is as much a work of art,[8] or artifice, as anything that can be mentioned. The energy localised in certain human bodies, directed by similarly localised intellects, has produced a collocation of other material bodies which could not be brought about in the state of nature. The same proposition is true of all the [11] works of man's hands, from a flint implement to a cathedral or a chronometer; and it is because it is true, that we call these things artificial, term them works of art, or artifice, by way of distinguishing them from the products of the cosmic process, working outside man, which we call natural, or works of nature. The distinction thus drawn between the works of nature and those of man, is universally recognised; and it is, as I conceive, both useful and justifiable.

III.

No doubt, it may be properly urged that the operation of human energy and intelligence, which has brought into existence and maintains the garden, by what I have called "the horticultural process," is, strictly speaking, part and parcel of the cosmic process. And no one could more readily agree to that proposition than I. In fact, I do not know that any one has taken more pains than I have, during the last thirty years, to insist upon the doctrine, so much reviled in the early part of that period, that man, physical, intellectual, and moral, is as much a part of nature, as purely a product of the cosmic process, as the humblest weed.[9]

But if, following up this admission, it is urged [12] that, such being the case, the cosmic process cannot be in antagonism with that horticultural process which is part of itself–I can only reply, that if the

conclusion that the two are antagonistic is logically absurd, I am sorry for logic, because, as we have seen, the fact is so. The garden is in the same position as every other work of man's art; it is a result of the cosmic process working through and by human energy and intelligence; and, as is the case with every other artificial thing set up in the state of nature, the influences of the latter are constantly tending to break it down and destroy it. No doubt, the Forth bridge and an ironclad in the offing, are, in ultimate resort, products of the cosmic process; as much so as the river which flows under the one, or the seawater on which the other floats. Nevertheless, every breeze strains the bridge a little, every tide does something to weaken its foundations; every change of temperature alters the adjustment of its parts, produces friction and consequent wear and tear. From time to time, the bridge must be repaired, just as the ironclad must go into dock; simply because nature is always tending to reclaim that which her child, man, has borrowed from her and has arranged in combinations which are not those favoured by the general cosmic process.

Thus, it is not only true that the cosmic energy, working through man upon a portion of the [13] plant world, opposes the same energy as it works through the state of nature, but a similar antagonism is everywhere manifest between the artificial and the natural. Even in the state of nature itself, what is the struggle for existence but the antagonism of the results of the cosmic process in the region of life, one to another?[10]

IV.

Not only is the state of nature hostile to the state of art of the garden; but the principle of the horticultural process, by which the latter is created and maintained, is antithetic to that of the cosmic process. The characteristic feature of the latter is the intense and unceasing competition of the struggle for existence. The characteristic of the former is the elimination of that struggle, by the removal of the conditions which give rise to it. The tendency of the cosmic process is to bring about the adjustment of the forms of plant life to the current conditions; the tendency of the horticultural process is the adjustment of the conditions to the needs of the forms of plant life which the gardener desires to raise.

The cosmic process uses unrestricted multiplica[14]tion as the means whereby hundreds compete for the place and nourishment adequate for one; it employs frost and drought to cut off the weak and unfortunate; to survive, there is need not only of strength, but of flexibility and of good fortune.

The gardener, on the other hand, restricts multiplication; provides that each plant shall have sufficient space and nourishment; protects from frost and drought; and, in every other way, attempts to modify the conditions, in such a manner as to bring about the survival of those forms which most nearly approach the standard of the useful, or the beautiful, which he has in his mind.

If the fruits and the tubers, the foliage and the flowers thus obtained, reach, or sufficiently approach, that ideal, there is no reason why the *status quo* attained should not be indefinitely prolonged. So long as the state of nature remains approximately the same, so long will the energy and intelligence which created the garden suffice to maintain it. However, the limits within which this mastery of man over nature can

be maintained are narrow. If the conditions of the cretaceous epoch returned, I fear the most skilful of gardeners would have to give up the cultivation of apples and gooseberries; while, if those of the glacial period once again obtained, open asparagus beds would be superfluous, and the training of fruit trees [15] against the most favourable of south walls, a waste of time and trouble.

But it is extremely important to note that, the state of nature remaining the same, if the produce does not satisfy the gardener, it may be made to approach his ideal more closely. Although the struggle for existence may be at end, the possibility of progress remains. In discussions on these topics, it is often strangely forgotten that the essential conditions of the modification, or evolution, of living things are variation and hereditary transmission. Selection is the means by which certain variations are favoured and their progeny preserved. But the struggle for existence is only one of the means by which selection may be effected. The endless varieties of cultivated flowers, fruits, roots, tubers and bulbs are not products of selection by means of the struggle for existence, but of direct selection, in view of an ideal of utility or beauty. Amidst a multitude of plants, occupying the same station and subjected to the same conditions, in the garden, varieties arise. The varieties tending in a given direction are preserved, and the rest are destroyed. And the same process takes place among the varieties until, for example, the wild kale becomes a cabbage, or the wild *Viola tricolor* a prize pansy.

[16]

V.

The process of colonization presents analogies to the formation of a garden which are highly instructive. Suppose a shipload of English colonists sent to form a settlement, in such a country as Tasmania was in the middle of the last century. On landing, they find themselves in the midst of a state of nature, widely different from that left behind them in everything but the most general physical conditions. The common plants, the common birds and quadrupeds, are as totally distinct as the men from anything to be seen on the side of the globe from which they come. The colonists proceed to put an end to this state of things over as large an area as they desire to occupy. They clear away the native vegetation, extirpate or drive out the animal population, so far as may be necessary, and take measures to defend themselves from the re-immigration of either. In their place, they introduce English grain and fruit trees; English dogs, sheep, cattle, horses; and English men; in fact, they set up a new Flora and Fauna and a new variety of mankind, within the old state of nature. Their farms and pastures represent a garden on a great scale, and themselves the gardeners who have to keep it up, in watchful antagonism to the old *regime.* Considered as a whole, the colony is a composite unit introduced into the old state of nature; and, [17] thenceforward, a competitor in the struggle for existence, to conquer or be vanquished.

Under the conditions supposed, there is no doubt of the result, if the work of the colonists be carried out energetically and with intelligent combination of all their forces. On the other hand, if they are slothful, stupid, and careless; or if they waste their energies in contests with one another, the chances are that the old state of nature will have the best of it. The native savage will destroy the immigrant civilized man; of the English animals and plants some will be extirpated by their indigenous rivals, others will pass into

the feral state and themselves become components of the state of nature. In a few decades, all other traces of the settlement will have vanished.

VI.

Let us now imagine that some administrative authority, as far superior in power and intelligence to men, as men are to their cattle, is set over the colony, charged to deal with its human elements in such a manner as to assure the victory of the settlement over the antagonistic influences of the state of nature in which it is set down. He would proceed in the same fashion as that in which the gardener dealt with his garden. In the first place, he would, as far as possible, put a [18] stop to the influence of external competition by thoroughly extirpating and excluding the native rivals, whether men, beasts, or plants. And our administrator would select his human agents, with a view to his ideal of a successful colony, just as the gardener selects his plants with a view to his ideal of useful or beautiful products.

In the second place, in order that no struggle for the means of existence between these human agents should weaken the efficiency of the corporate whole in the battle with the state of nature, he would make arrangements by which each would be provided with those means; and would be relieved from the fear of being deprived of them by his stronger or more cunning fellows. Laws, sanctioned by the combined force of the colony, would restrain the self-assertion of each man within the limits required for the maintenance of peace. In other words, the cosmic struggle for existence, as between man and man, would be rigorously suppressed; and selection, by its means, would be as completely excluded as it is from the garden.

At the same time, the obstacles to the full development of the capacities of the colonists by other conditions of the state of nature than those already mentioned, would be removed by the creation of artificial conditions of existence of a more favourable character. Protection against extremes of heat and cold would [19] be afforded by houses and clothing; drainage and irrigation works would antagonise the effects of excessive rain and excessive drought; roads, bridges, canals, carriages, and ships would overcome the natural obstacles to locomotion and transport; mechanical engines would supplement the natural strength of men and of their draught animals; hygienic precautions would check, or remove, the natural causes of disease. With every step of this progress in civilization, the colonists would become more and more independent of the state of nature; more and more, their lives would be conditioned by a state of art. In order to attain his ends, the administrator would have to avail himself of the courage, industry, and co-operative intelligence of the settlers; and it is plain that the interest of the community would be best served by increasing the proportion of persons who possess such qualities, and diminishing that of persons devoid of them. In other words, by selection directed towards an ideal.

Thus the administrator might look to the establishment of an earthly paradise, a true garden of Eden, in which all things should work together towards the well-being of the gardeners: within which the cosmic process, the coarse struggle for existence of the state of nature, should be abolished; in which that state should be replaced by a state of art; [20] where every plant and every lower animal should be adapted to human wants, and would perish if human supervision and protection were withdrawn; where men

themselves should have been selected, with a view to their efficiency as organs for the performance of the functions of a perfected society. And this ideal polity would have been brought about, not by gradually adjusting the men to the conditions around them, but by creating artificial conditions for them; not by allowing the free play of the struggle for existence, but by excluding that struggle; and by substituting selection directed towards the administrator's ideal for the selection it exercises.

VII.

But the Eden would have its serpent, and a very subtle beast too. Man shares with the rest of the living world the mighty instinct of reproduction and its consequence, the tendency to multiply with great rapidity. The better the measures of the administrator achieved their object, the more completely the destructive agencies of the state of nature were defeated, the less would that multiplication be checked.

On the other hand, within the colony, the enforcement of peace, which deprives every man of the power to take away the means of existence from another, simply because he is the stronger, [21] would have put an end to the struggle for existence between the colonists, and the competition for the commodities of existence, which would alone remain, is no check upon population.

Thus, as soon as the colonists began to multiply, the administrator would have to face the tendency to the reintroduction of the cosmic struggle into his artificial fabric, in consequence of the competition, not merely for the commodities, but for the means of existence. When the colony reached the limit of possible expansion, the surplus population must be disposed of somehow; or the fierce struggle for existence must recommence and destroy that peace, which is the fundamental condition of the maintenance of the state of art against the state of nature.

Supposing the administrator to be guided by purely scientific considerations, he would, like the gardener, meet this most serious difficulty by systematic extirpation, or exclusion, of the superfluous. The hopelessly diseased, the infirm aged, the weak or deformed in body or in mind, the excess of infants born, would be put away, as the gardener pulls up defective and superfluous plants, or the breeder destroys undesirable cattle. Only the strong and the healthy, carefully matched, with a view to the progeny best adapted to the purposes of the administrator, would be permitted to perpetuate their kind.

[22]

VIII.

Of the more thoroughgoing of the multitudinous attempts to apply the principles of cosmic evolution, or what are supposed to be such, to social and political problems, which have appeared of late years, a considerable proportion appear to me to be based upon the notion that human society is competent to furnish, from its own resources, an administrator of the kind I have imagined. The pigeons, in short, are to be their own Sir John Sebright.[11] A despotic government, whether individual or collective, is to be endowed with the preternatural intelligence, and with what, I am afraid, many will consider the

preternatural ruthlessness, required for the purpose of carrying out the principle of improvement by selection, with the somewhat drastic thoroughness upon which the success of the method depends. Experience certainly does not justify us in limiting the ruthlessness of individual "saviours of society"; and, on the well-known grounds of the aphorism which denies both body and soul to corporations, it seems probable (indeed the belief is not without support in history) that a collective despotism, a mob got to believe in its own divine right by demogogic missionaries, would be capable of more thorough [23] work in this direction than any single tyrant, puffed up with the same illusion, has ever achieved. But intelligence is another affair. The fact that "saviours of society" take to that trade is evidence enough that they have none to spare. And such as they possess is generally sold to the capitalists of physical force on whose resources they depend. However, I doubt whether even the keenest judge of character, if he had before him a hundred boys and girls under fourteen, could pick out with the least chance of success, those who should be kept, as certain to be serviceable members of the polity, and those who should be chloroformed, as equally sure to be stupid, idle, or vicious. The "points" of a good or of a bad citizen are really far harder to discern than those of a puppy or a short-horn calf; many do not show themselves before the practical difficulties of life stimulate manhood to full exertion. And by that time the mischief is done. The evil stock, if it be one, has had time to multiply, and selection is nullified.

IX.

I have other reasons for fearing that this logical ideal of evolutionary regimentation–this pigeon-fanciers' polity–is unattainable. In the absence of any such a severely scientific administrator as we have been dreaming of, human society [24] is kept together by bonds of such a singular character, that the attempt to perfect society after his fashion would run serious risk of loosening them.

Social organization is not peculiar to men. Other societies, such as those constituted by bees and ants, have also arisen out of the advantage of cooperation in the struggle for existence; and their resemblances to, and their differences from, human society are alike instructive. The society formed by the hive bee fulfils the ideal of the communistic aphorism "to each according to his needs, from each according to his capacity." Within it, the struggle for existence is strictly limited. Queen, drones, and workers have each their allotted sufficiency of food; each performs the function assigned to it in the economy of the hive, and all contribute to the success of the whole co-operative society in its competition with rival collectors of nectar and pollen and with other enemies, in the state of nature without. In the same sense as the garden, or the colony, is a work of human art, the bee polity is a work of apiarian art, brought about by the cosmic process, working through the organization of the hymenopterous type.

Now this society is the direct product of an organic necessity, impelling every member of it to a course of action which tends to the good of the whole. Each bee has its duty and none [25] has any rights. Whether bees are susceptible of feeling and capable of thought is a question which cannot be dogmatically answered. As a pious opinion, I am disposed to deny them more than the merest rudiments of consciousness.[12] But it is curious to reflect that a thoughtful drone (workers and queens would have no leisure for speculation) with a turn for ethical philosophy, must needs profess himself an intuitive moralist of the purest water. He would point out, with perfect justice, that the devotion of the workers to

a life of ceaseless toil for a mere subsistence wage, cannot be accounted for either by enlightened selfishness, or by any other sort of utilitarian motives; since these bees begin to work, without experience or reflection, as they emerge from the cell in which they are hatched. Plainly, an eternal and immutable principle, innate in each bee, can alone account for the phenomena. On the other hand, the biologist, who traces out all the extant stages of gradation between solitary and hive bees, as clearly sees in the latter, simply the perfection of an automatic mechanism, hammered out by the blows of the struggle for existence upon the progeny of the former, during long ages of constant variation.

[26]

X.

I see no reason to doubt that, at its origin, human society was as much a product of organic necessity as that of the bees.[13] The human family, to begin with, rested upon exactly the same conditions as those which gave rise to similar associations among animals lower in the scale. Further, it is easy to see that every increase in the duration of the family ties, with the resulting co-operation of a larger and larger number of descendants for protection and defence, would give the families in which such modification took place a distinct advantage over the others. And, as in the hive, the progressive limitation of the struggle for existence between the members of the family would involve increasing efficiency as regards outside competition.

But there is this vast and fundamental difference between bee society and human society. In the former, the members of the society are each organically predestined to the performance of one particular class of functions only. If they were endowed with desires, each could desire to perform none but those offices for which its organization specially fits it; and which, in view of the good of the whole, it is proper it should do. So long as a new queen does not make her appearance, rivalries and competition are absent from the bee polity.

[27] Among mankind, on the contrary, there is no such predestination to a sharply defined place in the social organism. However much men may differ in the quality of their intellects, the intensity of their passions, and the delicacy of their sensations, it cannot be said that one is fitted by his organization to be an agricultural labourer and nothing else, and another to be a landowner and nothing else. Moreover, with all their enormous differences in natural endowment, men agree in one thing, and that is their innate desire to enjoy the pleasures and to escape the pains of life; and, in short, to do nothing but that which it pleases them to do, without the least reference to the welfare of the society into which they are born. That is their inheritance (the reality at the bottom of the doctrine of original sin) from the long series of ancestors, human and semi-human and brutal, in whom the strength of this innate tendency to self-assertion was the condition of victory in the struggle for existence. That is the reason of the *avidits vitæ*[14]–the insatiable hunger for enjoyment–of all mankind, which is one of the essential conditions of success in the war with the state of nature outside; and yet the sure agent of the destruction of society if allowed free play within.

The check upon this free play of self-assertion, or natural liberty, which is the necessary condition for the origin of human society, is the product [28] of organic necessities of a different kind from those upon which the constitution of the hive depends. One of these is the mutual affection of parent and offspring, intensified by the long infancy of the human species. But the most important is the tendency, so strongly developed in man, to reproduce in himself actions and feelings similar to, or correlated with, those of other men. Man is the most consummate of all mimics in the animal world; none but himself can draw or model; none comes near him in the scope, variety, and exactness of vocal imitation; none is such a master of gesture; while he seems to be impelled thus to imitate for the pure pleasure of it. And there is no such another emotional chameleon. By a purely reflex operation of the mind, we take the hue of passion of those who are about us, or, it may be, the complementary colour. It is not by any conscious "putting one's self in the place" of a joyful or a suffering person that the state of mind we call sympathy usually arises;[15] indeed, it is often contrary to one's sense of [29] right, and in spite of one's will, that "fellow-feeling makes us wondrous kind," or the reverse. However complete may be the indifference to public opinion, in a cool, intellectual view, of the traditional sage, it has not yet been my fortune to meet with any actual sage who took its hostile manifestations with entire equanimity. Indeed, I doubt if the philosopher lives, or ever has lived, who could know himself to be heartily despised by a street boy without some irritation. And, though one cannot justify Haman for wishing to hang Mordecai on such a very high gibbet, yet, really, the consciousness of the Vizier of Ahasuerus, as he went in and out of the gate, that this obscure Jew had no respect for him, must have been very annoying.[16]

It is needful only to look around us, to see that the greatest restrainer of the anti-social tendencies of men is fear, not of the law, but of the opinion of their fellows. The conventions of honour bind men who break legal, moral, and religious bonds; and, while people endure the extremity of physical pain rather than part with life, shame drives the weakest to suicide.

Every forward step of social progress brings men [30] into closer relations with their fellows, and increases the importance of the pleasures and pains derived from sympathy. We judge the acts of others by our own sympathies, and we judge our own acts by the sympathies of others, every day and all day long, from childhood upwards, until associations, as indissoluble as those of language, are formed between certain acts and the feelings of approbation or disapprobation. It becomes impossible to imagine some acts without disapprobation, or others without approbation of the actor, whether he be one's self, or any one else. We come to think in the acquired dialect of morals. An artificial personality, the "man within," as Adam Smith[17] calls conscience, is built up beside the natural personality. He is the watchman of society, charged to restrain the anti-social tendencies of the natural man within the limits required by social welfare.

XI.

I have termed this evolution of the feelings out of which the primitive bonds of human society are so largely forged, into the organized and personified sympathy we call conscience, the ethical process.[18] So far as it tends to [31] make any human society more efficient in the struggle for existence with the state

of nature, or with other societies, it works in harmonious contrast with the cosmic process. But it is none the less true that, since law and morals are restraints upon the struggle for existence between men in society, the ethical process is in opposition to the principle of the cosmic process, and tends to the suppression of the qualities best fitted for success in that struggle.[19]

It is further to be observed that, just as the self-assertion, necessary to the maintenance of society against the state of nature, will destroy that society if it is allowed free operation within; so the self-restraint, the essence of the ethical process, which is no less an essential condition of the existence of every polity, may, by excess, become ruinous to it.

Moralists of all ages and of all faiths, attending only to the relations of men towards one another in an ideal society, have agreed upon the "golden rule," "Do as you would be done by." In other words, let sympathy be your guide; put yourself in the place of the man towards whom your action is directed; and do to him what you would like to have done to yourself under the circumstances. However much one may admire the generosity of such a rule of con[32]duct; however confident one may be that average men may be thoroughly depended upon not to carry it out to its full logical consequences; it is nevertheless desirable to recognise the fact that these consequences are incompatible with the existence of a civil state, under any circumstances of this world which have obtained, or, so far as one can see, are, likely to come to pass.

For I imagine there can be no doubt that the great desire of every wrong-doer is to escape from the painful consequences of his actions. If I put myself in the place of the man who has robbed me, I find that I am possessed by an exceeding desire not to be fined or imprisoned; if in that of the man who has smitten me on one cheek, I contemplate with satisfaction the absence of any worse result than the turning of the other cheek for like treatment. Strictly observed, the "golden rule" involves the negation of law by the refusal to put it in motion against law-breakers; and, as regards the external relations of a polity, it is the refusal to continue the struggle for existence. It can be obeyed, even partially, only under the protection of a society which repudiates it. Without such shelter, the followers of the "golden rule" may indulge in hopes of heaven, but they must reckon with the certainty that other people will be masters of the earth.

What would become of the garden if the gar[33]dener treated all the weeds and slugs and birds and trespassers as he would like to be treated, if he were in their place?

XII.

Under the preceding heads, I have endeavoured to represent in broad, but I hope faithful, outlines the essential features of the state of nature and of that cosmic process of which it is the outcome, so far as was needful for my argument; I have contrasted with the state of nature the state of art, produced by human intelligence and energy, as it is exemplified by a garden; and I have shown that the state of art, here and elsewhere, can be maintained only by the constant counteraction of the hostile influences of the state of nature. Further, I have pointed out that the "horticultural process" which thus sets itself against

the "cosmic process" is opposed to the latter in principle, in so far as it tends to arrest the struggle for existence, by restraining the multiplication which is one of the chief causes of that struggle, and by creating artificial conditions of life, better adapted to the cultivated plants than are the conditions of the state of nature. And I have dwelt upon the fact that, though the progressive modification, which is the consequence of the struggle for existence in the state of nature, is at an end, such modification may still be effected by that [34] selection, in view of an ideal of usefulness, or of pleasantness, to man, of which the state of nature knows nothing.

I have proceeded to show that a colony, set down in a country in the state of nature, presents close analogies with a garden; and I have indicated the course of action which an administrator, able and willing to carry out horticultural principles, would adopt, in order to secure the success of such a newly formed polity, supposing it to be capable of indefinite expansion. In the contrary case, I have shown that difficulties must arise; that the unlimited increase of the population over a limited area must, sooner or later, reintroduce into the colony that struggle for the means of existence between the colonists, which it was the primary object of the administrator to exclude, insomuch as it is fatal to the mutual peace which is the prime condition of the union of men in society.

I have briefly described the nature of the only radical cure, known to me, for the disease which would thus threaten the existence of the colony; and, however regretfully, I have been obliged to admit that this rigorously scientific method of applying the principles of evolution to human society hardly comes within the region of practical politics; not for want of will on the part of a great many people; but because, for one reason, there is no hope that mere human beings will ever possess enough intelligence to select the fittest. And I [35] have adduced other grounds for arriving at the same conclusion.

I have pointed out that human society took its rise in the organic necessities expressed by imitation and by the sympathetic emotions; and that, in the struggle for existence with the state of nature and with other societies, as part of it, those in which men were thus led to close co-operation had a great advantage.[20] But, since each man retained more or less of the faculties common to all the rest, and especially a full share of the desire for unlimited self-gratification, the struggle for existence within society could only be gradually eliminated. So long as any of it remained, society continued to be an imperfect instrument of the struggle for existence and, consequently, was improvable by the selective influence of that struggle. Other things being alike, the tribe of savages in which order was best maintained; in which there was most security within the tribe and the most loyal mutual support outside it; would be the survivors.

I have termed this gradual strengthening of the social bond, which, though it arrests the struggle for existence inside society, up to a certain point improves the chances of society, as a corporate whole, in the cosmic struggle–the ethical process. I have endeavoured to show that, when the ethical process has advanced so far as to secure every member of the society in the possession of the means of existence, the struggle for existence, as between man and man, within that society is, *ipso facto,* at an end. And, as it is undeniable that the most highly civilized societies have substantially reached this position, it follows that, so far as they are concerned, the struggle for existence can play no important part within them.[21] In

other words, the kind of evolution which is brought about in the state of nature cannot take place.

I have further shown cause for the belief that direct selection, after the fashion of the horticulturist and the breeder, neither has played, nor can play, any important part in the evolution of society; apart from other reasons, because I do not see how such selection could be practised without a serious weakening, it may be the destruction, of the bonds which hold society together. It strikes me that men who are accustomed to contemplate the active or passive extirpation of the weak, the unfortunate, and the superfluous; who justify that conduct on the ground that it has the sanction of the cosmic process, and is the only way of ensuring the progress of the race; who, if [37] they are consistent, must rank medicine among the black arts and count the physician a mischievous preserver of the unfit; on whose matrimonial undertakings the principles of the stud have the chief influence; whose whole lives, therefore, are an education in the noble art of suppressing natural affection and sympathy, are not likely to have any large stock of these commodities left. But, without them, there is no conscience, nor any restraint on the conduct of men, except the calculation of self-interest, the balancing of certain present gratifications against doubtful future pains; and experience tells us how much that is worth. Every day, we see firm believers in the hell of the theologians commit acts by which, as they believe when cool, they risk eternal punishment; while they hold back from those which are opposed to the sympathies of their associates.

XIII.

That progressive modification of civilization which passes by the name of the "evolution of society," is, in fact, a process of an essentially different character, both from that which brings about the evolution of species, in the state of nature, and from that which gives rise to the evolution of varieties, in the state of art.

There can be no doubt that vast changes have taken place in English civilization since the reign [38] of the Tudors. But I am not aware of a particle of evidence in favour of the conclusion that this evolutionary process has been accompanied by any modification of the physical, or the mental, characters of the men who have been the subjects of it. I have not met with any grounds for suspecting that the average Englishmen of to-day are sensibly different from those that Shakspere knew and drew. We look into his magic mirror of the Elizabethan age, and behold, nowise darkly, the presentment of ourselves.

During these three centuries, from the reign of Elizabeth to that of Victoria, the struggle for existence between man and man has been so largely restrained among the great mass of the population (except for one or two short intervals of civil war), that it can have had little, or no, selective operation. As to anything comparable to direct selection, it has been practised on so small a scale that it may also be neglected. The criminal law, in so far as by putting to death, or by subjecting to long periods of imprisonment, those who infringe its provisions, it prevents the propagation of hereditary criminal tendencies; and the poor-law, in so far as it separates married couples, whose destitution arises from hereditary defects of character, are doubtless selective agents operating in favour of the non-criminal and

the more effective members of society. But the proportion of the population which they influence [39] is very small; and, generally, the hereditary criminal and the hereditary pauper have propagated their kind before the law affects them. In a large proportion of cases, crime and pauperism have nothing to do with heredity; but are the consequence, partly, of circumstances and, partly, of the possession of qualities, which, under different conditions of life, might have excited esteem and even admiration. It was a shrewd man of the world who, in discussing sewage problems, remarked that dirt is riches in the wrong place; and that sound aphorism has moral applications. The benevolence and open-handed generosity which adorn a rich man, may make a pauper of a poor one; the energy and courage to which the successful soldier owes his rise, the cool and daring subtlety to which the great financier owes his fortune, may very easily, under unfavourable conditions, lead their possessors to the gallows, or to the hulks. Moreover, it is fairly probable that the children of a 'failure' will receive from their other parent just that little modification of character which makes all the difference. I sometimes wonder whether people, who talk so freely about extirpating the unfit, ever dispassionately consider their own history. Surely, one must be very 'fit,' indeed, not to know of an occasion, or perhaps two, in one's life, when it would have been only too easy to qualify for a place among the 'unfit.'

[40] In my belief the innate qualities, physical, intellectual, and moral, of our nation have remained substantially the same for the last four or five centuries. If the struggle for existence has affected us to any serious extent (and I doubt it) it has been, indirectly, through our military and industrial wars with other nations.

XIV.

What is often called the struggle for existence in society (I plead guilty to having used the term too loosely myself), is a contest, not for the means of existence, but for the means of enjoyment. Those who occupy the first places in this practical competitive examination are the rich and the influential; those who fail, more or less, occupy the lower places, down to the squalid obscurity of the pauper and the criminal. Upon the most liberal estimate, I suppose the former group will not amount to two per cent. of the population. I doubt if the latter exceeds another two per cent.; but let it be supposed, for the sake of argument, that it is as great as five per cent.[22]

As it is only in the latter group that anything comparable to the struggle for existence in the state of nature can take place; as it is only [41] among this twentieth of the whole people that numerous men, women, and children die of rapid or slow starvation, or of the diseases incidental to permanently bad conditions of life; and as there is nothing to prevent their multiplication before they are killed off, while, in spite of greater infant mortality, they increase faster than the rich; it seems clear that the struggle for existence in this class can have no appreciable selective influence upon the other 95 per cent. of the population.

What sort of a sheep breeder would he be who should content himself with picking out the worst fifty out of a thousand, leaving them on a barren common till the weakest starved, and then letting the survivors go back to mix with the rest? And the parallel is too favourable; since in a large number of

cases, the actual poor and the convicted criminals are neither the weakest nor the worst.

In the struggle for the means of enjoyment, the qualities which ensure success are energy, industry, intellectual capacity, tenacity of purpose, and, at least as much sympathy as is necessary to make a man understand the feelings of his fellows. Were there none of those artificial arrangements by which fools and knaves are kept at the top of society instead of sinking to their natural place at the bottom,[23] the struggle for the means of [42] enjoyment would ensure a constant circulation of the human units of the social compound, from the bottom to the top and from the top to the bottom. The survivors of the contest, those who continued to form the great bulk of the polity, would not be those 'fittest' who got to the very top, but the great body of the moderately "fit" whose numbers and superior propagative power, enable them always to swamp the exceptionally endowed minority.

I think it must be obvious to every one, that, whether we consider the internal or the external interests of society, it is desirable they should be in the hands of those who are endowed with the largest share of energy, of industry, of intellectual capacity, of tenacity of purpose, while they are not devoid of sympathetic humanity; and, in so far as the struggle for the means of enjoyment tends to place such men in possession of wealth and influence, it is a process which tends to the good of society. But the process, as we have seen, has no real resemblance to that which adapts living beings to current conditions in the state of nature; nor any to the artificial selection of the horticulturist.

[43]

XV.

To return, once more, to the parallel of horticulture. In the modern world, the gardening of men by themselves is practically restricted to the performance, not of selection, but of that other function of the gardener, the creation of conditions more favourable than those of the state of nature; to the end of facilitating the free expansion of the innate faculties of the citizen, so far as it is consistent with the general good. And the business of the moral and political philosopher appears to me to be the ascertainment, by the same method of observation, experiment, and ratiocination, as is practised in other kinds of scientific work, of the course of conduct which will best conduce to that end.

But, supposing this course of conduct to be scientifically determined and carefully followed out, it cannot put an end to the struggle for existence in the state of nature; and it will not so much as tend, in any way, to the adaptation of man to that state. Even should the whole human race be absorbed in one vast polity, within which "absolute political justice" reigns, the struggle for existence with the state of nature outside it, and the tendency to the return of the struggle within, in consequence of over-multiplication, will remain; and, unless men's inheritance from the ancestors who fought a good fight in the state of [44] nature, their dose of original sin, is rooted out by some method at present unrevealed, at any rate to disbelievers in supernaturalism, every child born into the world will still bring with him the instinct of unlimited self-assertion. He will have to learn the lesson of self-restraint and renunciation. But the practice of self-restraint and renunciation is not happiness, though it may be something much

better.

That man, as a 'political animal,' is susceptible of a vast amount of improvement, by education, by instruction, and by the application of his intelligence to the adaptation of the conditions of life to his higher needs, I entertain not the slightest doubt. But, so long as he remains liable to error, intellectual or moral; so long as he is compelled to be perpetually on guard against the cosmic forces, whose ends are not his ends, without and within himself; so long as he is haunted by inexpugnable memories and hopeless aspirations; so long as the recognition of his intellectual limitations forces him to acknowledge his incapacity to penetrate the mystery of existence; the prospect of attaining untroubled happiness, or of a state which can, even remotely, deserve the title of perfection, appears to me to be as misleading an illusion as ever was dangled before the eyes of poor humanity. And there have been many of them.

That which lies before the human race is a constant struggle to maintain and improve, in [45] opposition to the State of Nature, the State of Art of an organized polity; in which, and by which, man may develop a worthy civilization, capable of maintaining and constantly improving itself, until the evolution of our globe shall have entered so far upon its downward course that the cosmic process resumes its sway; and, once more, the State of Nature prevails over the surface of our planet.

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[1] See "On a piece of Chalk" in the preceding volume of these Essays (vol. viii, p. 1.).

[2] That every theory of evolution must be consistent not merely with progressive development, but with indefinite persistence in the same condition and with retrogressive modification, is a point which I have insisted upon repeatedly from this year 1862 till now. See *Collected Essays*, vol. ii, pp. 461-89; vol. iii, p. 33; vol. viii, p. 304. In the address on "Geological Contemporaneity and Persistent Types" (1862), the paleontological proofs of this proposition were, I believe, first set forth.

[3] "On the Border Territory between the Animal and the Vegetable Kingdoms," Essays, vol. viii, p. 162.

[4] See "Evolution in Biology," Essays, vol. ii. p. 187.

[5] *Collected Essays,* vol. ii, *passim.*

[6] *Ibid.,* vol. iv, p. 138; vol. v. pp. 71-73.

[7] *Ibid.,* vol. viii, p. 321.

[8] The sense of the term "Art" is becoming narrowed; "work of Art" to most people means a picture, a statue, or a piece of *bijouterie;* by way of compensation "artist" has included in its wide embrace cooks and ballet girls, no less than painters and sculptors.

[9] See "Man's Place in Nature," *Collected Essays* vol. vii, and "On the Struggle for Existence in Human Society" (1888) below.

[10] Or to put the case still more simply. When a man lays hold of the two ends of a piece of string and pulls them, with intent to break it, the right arm is certainly exerted in antagonism to the left arm; yet both arms derive their energy from the same original source.

[11] Not that the conception of such a society is necessarily based upon the idea of evolution. The Platonic state testifies to the contrary.

[12] *Collected Essays*, vol. i., "Animal Automatism"; vol. v., "Prologue," pp. 45 *et. seq.*

[13] *Collected Essays*, vol. v., Prologue, pp. 50-54.

[14] See below. Romanes' Lecture, note 7.

[15] Adam Smith makes the pithy observation that the man who sympathises with a woman in childbed, cannot be said to put himself in her place. ("The Theory of the Moral Sentiments," Part vii. sec. iii. chap. i.) Perhaps there is more humour than force in the example; and, in spite of this and other observations of the same tenor, I think that the one defect of the remarkable work in which it occurs is that it lays too much stress on conscious substitution, too little on purely reflex sympathy.

[16] Esther v. 9-13. ". . . but when Haman saw Mordecai in the king's gate, that he stood not up, nor moved for him, he was full of indignation against Mordecai. . . . And Haman told them of the glory of his riches . . . and all the things wherein the king had promoted him.... Yet all this availeth me nothing, so long as I see Mordecai the Jew sitting at the king's gate." What a shrewd exposure of human weakness it is!

[17] "Theory of the Moral Sentiments," Part iii. chap. 3. *On the influence and authority of conscience* .

[18] Worked out, in its essential features, chiefly by Hartley and Adam Smith, long before the modern doctrine of evolution was thought of. See *Note* below, p. 45.

[19] See the essay "On the Struggle for Existence in Human Society" below; and *Collected Essays*, vol. i. p. 276, for Kant's recognition of these facts.

[20] *Collected Essays*, vol. v., Prologue, p. 52.

[21] Whether the struggle for existence with the state of nature and with other societies, so far as they stand in the relation of the state of nature with it, exerts a selective influence upon modern society, and in what direction, are questions not easy to answer. The problem of the effect of military and industrial warfare upon those who wage it is very complicated.

[22] Those who read the last Essay in this volume will not accuse me of wishing to attenuate the evil of the existence of this group, whether great or small.

[23] I have elsewhere lamented the absence from society of a machinery for facilitating the descent of incapacity. "Administrative Nihilism." *Collected Essays*, vol. i, p. 54.

Note (see p. 30).–It seems the fashion nowadays to ignore Hartley; though, a century and a half ago, he not only laid the foundations but built up much of the superstructure of a true theory of the Evolution of the intellectual and moral faculties. He speaks of what I have termed the ethical process as "our Progress from Self-interest to Self-annihilation." *Observations on Man* (1749), vol. ii, p. 281.

Romanes T. H. H

Huxley at time of delivery of Romanes Lecture

Photograph by W. and D. Downey (1893)

Evolution and Ethics

[*The Romanes Lecture,* 1893]

Collected Essays IX

[46] Soleo enim et in aliena castra transire, non tanquam transfuga sed tanquam explorator. (*L.* Annai Senecæ Epist. II. 4.)

There is a delightful child's story, known by the title of "Jack and the Bean-stalk," with which my contemporaries who are present will be familiar. But so many of our grave and reverend juniors have been brought up on severer intellectual diet, and, perhaps, have become acquainted with fairyland only through primers of comparative mythology, that it may be needful to give an outline of the tale. It is a

legend of a bean-plant, which grows and grows until it reaches the high heavens and there spreads out into a vast canopy of foliage. The hero, being moved to climb the stalk, discovers that the leafy expanse supports a world composed of the same elements as that below, but yet strangely new; and his adventures there, on which I may not dwell, must have com[47]pletely changed his views of the nature of things; though the story, not having been composed by, or for, philosophers, has nothing to say about views.

My present enterprise has a certain analogy to that of the daring adventurer. I beg you to accompany me in an attempt to reach a world which, to many, is probably strange, by the help of a bean. It is, as you know, a simple, inert looking thing. Yet, if planted under proper conditions, of which sufficient warmth is one of the most important, it manifests active powers of a very remarkable kind. A small green seedling emerges, rises to the surface of the soil, rapidly increases in size and, at the same time, undergoes a series of metamorphoses which do not excite our wonder as much as those which meet us in legendary history, merely because they are to be seen every day and all day long.

By insensible steps, the plant builds itself up into a large and various fabric of root, stem, leaves, flowers, and fruit, every one moulded within and without in accordance with an extremely complex but, at the same time, minutely defined pattern. In each of these complicated structures, as in their smallest constituents, there is an immanent energy which, in harmony with that resident in all the others, incessantly works towards the maintenance of the whole and the efficient performance of the part which it has to play in the economy of nature. [48] But no sooner has the edifice, reared with such exact elaboration, attained completeness, than it begins to crumble. By degrees, the plant withers and disappears from view, leaving behind more or fewer apparently inert and simple bodies, just like the bean from which it sprang; and, like it, endowed with the potentiality of giving rise to a similar cycle of manifestations.

Neither the poetic nor the scientific imagination is put to much strain in the search after analogies with this process of going forth and, as it were, returning to the starting-point. It may be likened to the ascent and descent of a slung stone, or the course of an arrow along its trajectory. Or we may say that the living energy takes first an upward and then a downward road. Or it may seem preferable to compare the expansion of the germ into the full-grown plant, to the unfolding of a fan, or to the rolling forth and widening of a stream; and thus to arrive at the conception of 'development,' or 'evolution.' Here as elsewhere, names are 'noise and smoke'; the important point is to have a clear and adequate conception of the fact signified by a name. And, in this case, the fact is the Sisyphæan process, in the course of which, the living and growing plant passes from the relative simplicity and latent potentiality of the seed to the full epiphany of a highly differentiated type, thence to fall back to simplicity and potentiality.

[49] The value of a strong intellectual grasp of the nature of this process lies in the circumstance that what is true of the bean is true of living things in general. From very low forms up to the highest–in the animal no less than in the vegetable kingdom–the process of life presents the same appearance[1] of cyclical evolution. Nay, we have but to cast our eyes over the rest of the world and cyclical change presents itself on all sides. It meets us in the water that flows to the sea and returns to the springs; in the

heavenly bodies that wax and wane, go and return to their places; in the inexorable sequence of the ages of man's life; in that successive rise, apogee, and fall of dynasties and of states which is the most prominent topic of civil history.

As no man fording a swift stream can dip his foot twice into the same water, so no man can, with exactness, affirm of anything in the sensible world that it is.[2] As he utters the words, nay, as he thinks them, the predicate ceases to be applicable; the present has become the past; the 'is' should be 'was.' And the more we learn of the nature of things, the more evident is it that what we call rest is only unperceived activity; that seeming peace is silent but strenuous battle. In every part, at every moment, the state of the cosmos is the expression of a transitory adjustment of contending forces; a scene of strife, in which all the combatants fall in turn. What is [50] true of each part, is true of the whole. Natural knowledge tends more and more to the conclusion that "all the choir of heaven and furniture of the earth" are the transitory forms of parcels of cosmic substance wending along the road of evolution, from nebulous potentiality, through endless growths of sun and planet and satellite; through all varieties of matter; through infinite diversities of life and thought; possibly, through modes of being of which we neither have a conception, nor are competent to form any, back to the indefinable latency from which they arose. Thus the most obvious attribute of the cosmos is its impermanence. It assumes the aspect not so much of a permanent entity as of a changeful process, in which naught endures save the flow of energy and the rational order which pervades it.

We have climbed our bean-stalk and have reached a wonderland in which the common and the familiar become things new and strange. In the exploration of the cosmic process thus typified, the highest intelligence of man finds inexhaustible employment; giants are subdued to our service; and the spiritual affections of the contemplative philosopher are engaged by beauties worthy of eternal constancy.

But there is another aspect of the cosmic process, so perfect as a mechanism, so beautiful as a work of art. Where the cosmopoietic energy works [51] through sentient beings, there arises, among its other manifestations, that which we call pain or suffering. This baleful product of evolution increases in quantity and in intensity, with advancing grades of animal organization, until it attains its highest level in man. Further, the consummation is not reached in man, the mere animal; nor in man, the whole or half savage; but only in man, the member of an organized polity. And it is a necessary consequence of his attempt to live in this way; that is, under those conditions which are essential to the full development of his noblest powers.

Man, the animal, in fact, has worked his way to the headship of the sentient world, and has become the superb animal which he is, in virtue of his success in the struggle for existence. The conditions having been of a certain order, man's organization has adjusted itself to them better than that of his competitors in the cosmic strife. In the case of mankind, the self-assertion, the unscrupulous seizing upon all that can be grasped, the tenacious holding of all that can be kept, which constitute the essence of the struggle for existence, have answered. For his successful progress, throughout the savage state, man has been largely indebted to those qualities which he shares with the ape and the tiger; his exceptional physical organization; his cunning, his sociability, his curiosity, and his imitativeness; his ruthless [52] and

ferocious destructiveness when his anger is roused by opposition.

But, in proportion as men have passed from anarchy to social organization, and in proportion as civilization has grown in worth, these deeply ingrained serviceable qualities have become defects. After the manner of successful persons, civilized man would gladly kick down the ladder by which he has climbed. He would be only too pleased to see 'the ape and tiger die.' But they decline to suit his convenience; and the unwelcome intrusion of these boon companions of his hot youth into the ranged existence of civil life adds pains and griefs, innumerable and immeasurably great, to those which the cosmic process necessarily brings on the mere animal. In fact, civilized man brands all these ape and tiger promptings with the name of sins; he punishes many of the acts which flow from them as crimes; and, in extreme cases, he does his best to put an end to the survival of the fittest of former days by axe and rope.

I have said that civilized man has reached this point; the assertion is perhaps too broad and general; I had better put it that ethical man has attained thereto. The science of ethics professes to furnish us with a reasoned rule of life; to tell us what is right action and why it is so. Whatever differences of opinion may exist among experts, there is a general consensus that the ape and tiger [53] methods of the struggle for existence are not reconcilable with sound ethical principles.

The hero of our story descended the bean-stalk, and came back to the common world, where fare and work were alike hard; where ugly competitors were much commoner than beautiful princesses; and where the everlasting battle with self was much less sure to be crowned with victory than a turn-to with a giant. We have done the like. Thousands upon thousands of our fellows, thousands of years ago, have preceded us in finding themselves face to face with the same dread problem of evil. They also have seen that the cosmic process is evolution; that it is full of wonder, full of beauty, and, at the same time, full of pain. They have sought to discover the bearing of these great facts on ethics; to find out whether there is, or is not, a sanction for morality in the ways of the cosmos.

Theories of the universe, in which the conception of evolution plays a leading part, were extant at least six centuries before our era. Certain knowledge of them, in the fifth century, reaches us from localities as distant as the valley of the Ganges and the Asiatic coasts of the Ægean. To the early philosophers of Hindostan, no less than to those of Ionia, the salient and characteristic feature of the phenomenal world was its change[54]fulness; the unresting flow of all things, through birth to visible being and thence to not being, in which they could discern no sign of a beginning and for which they saw no prospect of an ending. It was no less plain to some of these antique fore-runners of modern philosophy that suffering is the badge of all the tribe of sentient things; that it is no accidental accompaniment, but an essential constituent of the cosmic process. The energetic Greek might find fierce joys in a world in which 'strife is father and king'; but the old Aryan spirit was subdued to quietism in the Indian sage; the mist of suffering which spread over humanity hid everything else from his view; to him life was one with suffering and suffering with life.

In Hindostan, as in Ionia, a period of relatively high and tolerably stable civilization had succeeded long

ages of semi-barbarism and struggle. Out of wealth and security had come leisure and refinement, and, close at their heels, had followed the malady of thought. To the struggle for bare existence, which never ends, though it may be alleviated and partially disguised for a fortunate few, succeeded the struggle to make existence intelligible and to bring the order of things into harmony with the moral sense of man, which also never ends, but, for the thinking few, becomes keener with every increase of knowledge and with every step towards the realization of a worthy ideal of life.

[55] Two thousand five hundred years ago, the value of civilization was as apparent as it is now; then, as now, it was obvious that only in the garden of an orderly polity can the finest fruits humanity is capable of bearing be produced. But it had also become evident that the blessings of culture were not unmixed. The garden was apt to turn into a hothouse. The stimulation of the senses the pampering of the emotions, endlessly multiplied the sources of pleasure. The constant widening of the intellectual field indefinitely extended the range of that especially human faculty of looking before and after, which adds to the fleeting present those old and new worlds of the past and the future, wherein men dwell the more the higher their culture. But that very sharpening of the sense and that subtle refinement of emotion, which brought such a wealth of pleasures, were fatally attended by a proportional enlargement of the capacity for suffering; and the divine faculty of imagination, while it created new heavens and new earths, provided them with the corresponding hells of futile regret for the past and morbid anxiety for the future.[3] Finally, the inevitable penalty of over-stimulation, exhaustion, opened the gates of civilization to its great enemy, ennui; the stale and flat weariness when man delights not, nor woman neither; when all things are vanity and vexation; and life seems not worth living except to escape the bore of dying.

[56] Even purely intellectual progress brings about its revenges. Problems settled in a rough and ready way by rude men, absorbed in action, demand renewed attention and show themselves to be still unread riddles when men have time to think. The beneficent demon, doubt, whose name is Legion and who dwells amongst the tombs of old faiths, enters into mankind and thenceforth refuses to be cast out. Sacred customs, venerable dooms of ancestral wisdom, hallowed by tradition and professing to hold good for all time, are put to the question. Cultured reflection asks for their credentials; judges them by its own standards; finally, gathers those of which it approves into ethical systems, in which the reasoning is rarely much more than a decent pretext for the adoption of foregone conclusions.

One of the oldest and most important elements in such systems is the conception of justice. Society is impossible unless those who are associated agree to observe certain rules of conduct towards one another; its stability depends on the steadiness with which they abide by that agreement; and, so far as they waver, that mutual trust which is the bond of society is weakened or destroyed. Wolves could not hunt in packs except for the real, though unexpressed, understanding that they should not attack one another during the chase. The most rudimentary polity is a pack of men living under the like tacit, [57] or expressed, understanding; and having made the very important advance upon wolf society, that they agree to use the force of the whole body against individuals who violate it and in favour of those who observe it. This observance of a common understanding, with the consequent distribution of punishments and rewards according to accepted rules, received the name of justice, while the contrary was called injustice. Early ethics did not take much note of the animus of the violator of the rules. But

civilization could not advance far, without the establishment of a capital distinction between the case of involuntary and that of wilful misdeed; between a merely wrong action and a guilty one. And, with increasing refinement of moral appreciation, the problem of desert, which arises out of this distinction, acquired more and more theoretical and practical importance. If life must be given for life, yet it was recognized that the unintentional slayer did not altogether deserve death; and, by a sort of compromise between the public and the private conception of justice, a sanctuary was provided in which he might take refuge from the avenger of blood.

The idea of justice thus underwent a gradual sublimation from punishment and reward according to acts, to punishment and reward according to desert; or, in other words, according to motive. Righteousness, that is, action from right motive, [58] not only became synonymous with justice but the positive constituent of innocence and the very heart of goodness.

Now when the ancient sage, whether Indian or Greek, who had attained to this conception of goodness, looked the world, and especially human life, in the face, he found it as hard as we do to bring the course of evolution into harmony with even the elementary requirements of the ethical ideal of the just and the good.

If there is one thing plainer than another, it is that neither the pleasures nor the pains of life, in the merely animal world, are distributed according to desert; for it is admittedly impossible for the lower orders of sentient beings to deserve either the one or the other. If there is a generalization from the facts of human life which has the assent of thoughtful men in every age and country, it is that the violator of ethical rules constantly escapes the punishment which he deserves; that the wicked flourishes like a green bay tree, while the righteous begs his bread; that the sins of the fathers are visited upon the children; that, in the realm of nature, ignorance is punished just as severely as wilful wrong; and that thousands upon thousands of innocent beings suffer for the crime, or the unintentional trespass, of one.

Greek and Semite and Indian are agreed upon [59] this subject. The book of Job is at one with the "Works and Days" and the Buddhist Sutras; the Psalmist and the Preacher of Israel, with the Tragic Poets of Greece. What is a more common motive of the ancient tragedy in fact, than the unfathomable injustice of the nature of things; what is more deeply felt to be true than its presentation of the destruction of the blameless by the work of his own hands, or by the fatal operation of the sins of others? Surely Œdipus was pure of heart; it was the natural sequence of events–the cosmic process–which drove him, in all innocence, to slay his father and become the husband of his mother, to the desolation of his people and his own headlong ruin. Or to step, for a moment, beyond the chronological limits I have set myself, what constitutes the sempiternal attraction of Hamlet but the appeal to deepest experience of that history of a no less blameless dreamer, dragged, in spite of himself, into a world out of joint; involved in a tangle of crime and misery, created by one of the prime agents of the cosmic process as it works in and through man?

Thus, brought before the tribunal of ethics, the cosmos might well seem to stand condemned. The conscience of man revolted against the moral indifference of nature, and the microcosmic atom should

have found the illimitable macrocosm guilty. But few, or none, ventured to record that verdict.

[60] In the great Semitic trial of this issue, Job takes refuge in silence and submission; the Indian and the Greek, less wise perhaps, attempt to reconcile the irreconcilable and plead for the defendant. To this end, the Greeks invented Theodicies; while the Indians devised what, in its ultimate form, must rather be termed a Cosmodicy. For, though Buddhism recognizes gods many and lords many, they are products of the cosmic process; and transitory, however long enduring, manifestations of its eternal activity. In the doctrine of transmigration, whatever its origin, Brahminical and Buddhist speculation found, ready to hand,[4] the means of constructing a plausible vindication of the ways of the cosmos to man. If this world is full of pain and sorrow; if grief and evil fall, like the rain, upon both the just and the unjust; it is because, like the rain, they are links in the endless chain of natural causation by which past, present, and future are indissolubly connected; and there is no more injustice in the one case than in the other. Every sentient being is reaping as it has sown; if not in this life, then in one or other of the infinite series of antecedent existences of which it is the latest term. The present distribution of good and evil is, therefore, the algebraical sum of accumulated positive and negative deserts; or, rather, it depends on the floating balance of the account. For it was not thought necessary that a complete [61] settlement should ever take place. Arrears might stand over as a sort of 'hanging gale'; a period of celestial happiness just earned might be succeeded by ages of torment in a hideous nether world, the balance still overdue for some remote ancestral error.[5]

Whether the cosmic process looks any more moral than at first, after such a vindication, may perhaps be questioned. Yet this plea of justification is not less plausible than others; and none but very hasty thinkers will reject it on the ground of inherent absurdity. Like the doctrine of evolution itself, that of transmigration has its roots in the world of reality; and it may claim such support as the great argument from analogy is capable of supplying.

Everyday experience familiarizes us with the facts which are grouped under the name of heredity. Every one of us bears upon him obvious marks of his parentage, perhaps of remoter relationships. More particularly, the sum of tendencies to act in a certain way, which we call 'character,' is often to be traced through a long series of progenitors and collaterals. So we may justly say that this 'character'–this moral and intellectual essence of a man–does veritably pass over from one fleshly tabernacle to another, and does really transmigrate from generation to generation. In the new-born infant, the character of the stock lies latent, and the Ego is little more [62] than a bundle of potentialities. But, very early, these become actualities; from childhood to age they manifest themselves in dulness or brightness, weakness or strength, viciousness or uprightness; and with each feature modified by confluence with another character, if by nothing else, the character passes on to its incarnation in new bodies.

The Indian philosophers called character, as thus defined, 'karma.'[6] It is this karma which passed from life to life and linked them in the chain of transmigrations; and they held that it is modified in each life, not merely by confluence of parentage, but by its own acts. They were, in fact, strong believers in the theory, so much disputed just at present, of the hereditary transmission of acquired characters. That the manifestation of the tendencies of a character may be greatly facilitated, or impeded, by conditions, of

which self-discipline, or the absence of it, are among the most important, is indubitable; but that the character itself is modified in this way is by no means so certain; it is not so sure that the transmitted character of an evil liver is worse, or that of a righteous man better, than that which he received. Indian philosophy, however, did not admit of any doubt on this subject; the belief in the influence of conditions, notably of self-discipline, on the karma was not merely a necessary postulate of its theory of retribution, but it pre[63]sented the only way of escape from the endless round of transmigrations.

The earlier forms of Indian philosophy agreed with those prevalent in our own times, in supposing the existence of a permanent reality, or 'substance,' beneath the shifting series of phenomena, whether of matter or of mind. The substance of the cosmos was 'Brahma,' that of the individual man 'Atman'; and the latter was separated from the former only, if I may so speak, by its phenomenal envelope, by the casing of sensations, thoughts and desires, pleasures and pains, which make up the illusive phantasmagoria of life. This the ignorant take for reality; their 'Atman' therefore remains eternally imprisoned in delusions, bound by the fetters of desire and scourged by the whip of misery. But the man who has attained enlightenment sees that the apparent reality is mere illusion, or, as was said a couple of thousand years later, that there is nothing good nor bad but thinking makes it so. If the cosmos "is just and of our pleasant vices makes instruments to scourge us," it would seem that the only way to escape from our heritage of evil is to destroy that fountain of desire whence our vices flow; to refuse any longer to be the instruments of the evolutionary process, and withdraw from the struggle for existence. If the karma is modifiable by self-discipline, if its coarser desires, one after another, can be extinguished, the ultimate funda[64]mental desire of self-assertion, or the desire to be, may also be destroyed.[7] Then the bubble of illusion will burst, and the freed individual 'Atman' will lose itself in the universal 'Brahma.'

Such seems to have been the pre-Buddhistic conception of salvation, and of the way to be followed by those who would attain thereto. No more thorough mortification of the flesh has ever been attempted than that achieved by the Indian ascetic anchorite; no later monachism has so nearly succeeded in reducing the human mind to that condition of impassive quasi-somnambulism, which, but for its acknowledged holiness, might run the risk of being confounded with idiocy.

And this salvation, it will be observed, was to be attained through knowledge, and by action based on that knowledge; just as the experimenter, who would obtain a certain physical or chemical result, must have a knowledge of the natural laws involved and the persistent disciplined will adequate to carry out all the various operations required. The supernatural, in our sense of the term, was entirely excluded. There was no external power which could affect the sequence of cause and effect which gives rise to karma; none but the will of the subject of the karma which could put an end to it.

Only one rule of conduct could be based upon the remarkable theory of which I have endeavoured to give a reasoned outline. It was folly to continue [65] to exist when an overplus of pain was certain; and the probabilities in favour of the increase of misery with the prolongation of existence, were so overwhelming. Slaying the body only made matters worse; there was nothing for it but to slay the soul by the voluntary arrest of all its activities. Property, social ties, family affections, common companionship, must be abandoned; the most natural appetites, even that for food, must be suppressed,

or at least minimized; until all that remained of a man was the impassive, extenuated, mendicant monk, self-hypnotised into cataleptic trances, which the deluded mystic took for foretastes of the final union with Brahma.

The founder of Buddhism accepted the chief postulates demanded by his predecessors. But he was not satisfied with the practical annihilation involved in merging the individual existence in the unconditioned–the Atman in Brahma. It would seem that the admission of the existence of any substance whatever–even of the tenuity of that which has neither quality nor energy and of which no predicate whatever can be asserted–appeared to him to be a danger and a snare. Though reduced to a hypostatized negation, Brahma was not to be trusted; so long as entity was there, it might conceivably resume the weary round of evolution, with all its train of immeasurable miseries. Gautama got rid of even that [66] shade of a shadow of permanent existence by a metaphysical *tour de force* of great interest to the student of philosophy, seeing that it supplies the wanting half of Bishop Berkeley's well-known idealistic argument.

Granting the premises, I am not aware of any escape from Berkeley's conclusion, that the 'substance' of matter is a metaphysical unknown quantity, of the existence of which there is no proof. What Berkeley does not seem to have so clearly perceived is that the non-existence of a substance of mind is equally arguable; and that the result of the impartial applications of his reasonings is the reduction of the All to co-existences and sequences of phenomena, beneath and beyond which there is nothing cognoscible. It is a remarkable indication of the subtlety of Indian speculation that Gautama should have seen deeper than the greatest of modern idealists; though it must be admitted that, if some of Berkeley's reasonings respecting the nature of spirit are pushed home, they reach pretty much the same conclusion.[8]

Accepting the prevalent Brahminical doctrine that the whole cosmos, celestial, terrestrial, and infernal, with its population of gods and other celestial beings, of sentient animals, of Mara and his devils, is incessantly shifting through recurring cycles of production and destruction, in each of which every human being has his transmigratory [67] representative, Gautama proceeded to eliminate substance altogether; and to reduce the cosmos to a mere flow of sensations, emotions, volitions, and thoughts, devoid of any substratum. As, on the surface of a stream of water, we see ripples and whirlpools, which last for a while and then vanish with the causes that gave rise to them, so what seem individual existences are mere temporary associations of phenomena circling round a centre, "like a dog tied to a post." In the whole universe there is nothing permanent, no eternal substance either of mind or of matter. Personality is a metaphysical fancy; and in very truth, not only we, but all things, in the worlds without end of the cosmic phantasmagoria, are such stuff as dreams are made of.

What then becomes of karma? Karma remains untouched. As the peculiar form of energy we call magnetism may be transmitted from a loadstone to a piece of steel, from the steel to a piece of nickel, as it may be strengthened or weakened by the conditions to which it is subjected while resident in each piece, so it seems to have been conceived that karma might be transmitted from one phenomenal association to another by a sort of induction. However this may be, Gautama doubtless had a better guarantee for the abolition of transmigration, when no wrack of substance, either of Atman or of

Brahma, was left behind when, in short, a man had but to [68] dream that he willed not to dream, to put an end to all dreaming.

This end of life's dream is Nirvana. What Nirvana is the learned do not agree. But, since the best original authorities tell us there is neither desire nor activity, nor any possibility of phenomenal reappearance for the sage who has entered Nirvana, it may be safely said of this acme of Buddhistic philosophy–"the rest is silence."[9]

Thus there is no very great practical disagreement between Gautama and his predecessors with respect to the end of action; but it is otherwise as regards the means to that end. With just insight into human nature, Gautama declared extreme ascetic practices to be useless and indeed harmful. The appetites and the passions are not to be abolished by mere mortification of the body; they must, in addition, be attacked on their own ground and conquered by steady cultivation of the mental habits which oppose them; by universal benevolence; by the return of good for evil; by humility; by abstinence from evil thought; in short, by total renunciation of that self-assertion which is the essence of the cosmic process.

Doubtless, it is to these ethical qualities that Buddhism owes its marvellous success.[10] A system which knows no God in the western sense; which denies a soul to man; which counts the belief in immortality a blunder and the hope of it a sin; [69] which refuses any efficacy to prayer and sacrifice; which bids men look to nothing but their own efforts for salvation; which, in its original purity, knew nothing of vows of obedience, abhorred intolerance, and never sought the aid of the secular arm; yet spread over a considerable moiety of the Old World with marvellous rapidity, and is still, with whatever base admixture of foreign superstitions, the dominant creed of a large fraction of mankind.

Let us now set our faces westwards, towards Asia Minor and Greece and Italy, to view the rise and progress of another philosophy, apparently independent, but no less pervaded by the conception of evolution.[11]

The sages of Miletus were pronounced evolutionists; and, however dark may be some of the sayings of Heracleitus of Ephesus, who was probably a contemporary of Gautama, no better expressions of the essence of the modern doctrine of evolution can be found than are presented by some of his pithy aphorisms and striking metaphors.[12] Indeed, many of my present auditors must have observed that, more than once, I have borrowed from him in the brief exposition of the theory of evolution with which this discourse commenced.

But when the focus of Greek intellectual activity shifted to Athens, the leading minds concentrated [70] their attention upon ethical problems. Forsaking the study of the macrocosm for that of the microcosm, they lost the key to the thought of the great Ephesian, which, I imagine, is more intelligible to us than it was to Socrates, or to Plato. Socrates, more especially, set the fashion of a kind of inverse agnosticism, by teaching that the problems of physics lie beyond the reach of the human intellect; that the attempt to solve them is essentially vain; that the one worthy object of investigation is the problem of ethical life;

and his example was followed by the Cynics and the later Stoics. Even the comprehensive knowledge and the penetrating intellect of Aristotle failed to suggest to him that in holding the eternity of the world, within its present range of mutation, he was making a retrogressive step. The scientific heritage of Heracleitus passed into the hands neither of Plato nor of Aristotle, but into those of Democritus. But the world was not yet ready to receive the great conceptions of the philosopher of Abdera. It was reserved for the Stoics to return to the track marked out by the earlier philosophers; and, professing themselves disciples of Heracleitus, to develop the idea of evolution systematically. In doing this, they not only omitted some characteristic features of their master's teaching, but they made additions altogether foreign to it. One of the most influential of these importations was the transcen[71]dental theism which had come into vogue. The restless, fiery energy, operating according to law, out of which all things emerge and into which they return, in the endless successive cycles of the great year; which creates and destroys worlds as a wanton child builds up, and anon levels, sand castles on the seashore; was metamorphosed into a material world-soul and decked out with all the attributes of ideal Divinity; not merely with infinite power and transcendent wisdom, but with absolute goodness.

The consequences of this step were momentous. For if the cosmos is the effect of an immanent, omnipotent, and infinitely beneficent cause, the existence in it of real evil, still less of necessarily inherent evil, is plainly inadmissible.[13] Yet the universal experience of mankind testified then, as now, that, whether we look within us or without us, evil stares us in the face on all sides; that if anything is real, pain and sorrow and wrong are realities.

It would be a new thing in history if *a priori* philosophers were daunted by the factious opposition of experience; and the Stoics were the last men to allow themselves to be beaten by mere facts. 'Give me a doctrine and I will find the reasons for it,' said Chrysippus. So they perfected, if they did not invent, that ingenious and plausible form of pleading, the Theodicy; for the purpose of showing firstly, that there is no such [72] thing as evil; secondly, that if there is, it is the necessary correlate of good; and, moreover, that it is either due to our own fault, or inflicted for our benefit. Theodicies have been very popular in their time, and I believe that a numerous, though somewhat dwarfed, progeny of them still survives. So far as I know, they are all variations of the theme set forth in those famous six lines of the "Essay on Man," in which Pope sums up Bolingbroke's reminiscences of stoical and other speculations of this kind–

> "All nature is but art, unknown to thee;
> All chance, direction which thou canst not see;
> All discord, harmony not understood;
> All partial evil, universal good;
> And spite of pride, in erring reason's spite
> One truth is clear: whatever is is right."

Yet, surely, if there are few more important truths than those enunciated in the first triad, the second is open to very grave objections. That there is a 'soul of good in things evil' is unquestionable; nor will any wise man deny the disciplinary value of pain and sorrow. But these considerations do not help us to see why the immense multitude of irresponsible sentient beings, which cannot profit by such discipline,

should suffer; nor why, among the endless possibilities open to omnipotence–that of sinless, happy existence among the rest–the actuality in which sin and misery abound should be that selected. [73] Surely it is mere cheap rhetoric to call arguments which have never yet been answered by even the meekest and the least rational of Optimists, suggestions of the pride of reason. As to the concluding aphorism, its fittest place would be as an inscription in letters of mud over the portal of some 'stye of Epicurus';[14] for that is where the logical application of it to practice would land men, with every aspiration stifled and every effort paralyzed. Why try to set right what is right already? Why strive to improve the best of all possible worlds? Let us eat and drink, for as today all is right, so to-morrow all will be.

But the attempt of the Stoics to blind themselves to the reality of evil, as a necessary concomitant of the cosmic process, had less success than that of the Indian philosophers to exclude the reality of good from their purview. Unfortunately, it is much easier to shut one's eyes to good than to evil. Pain and sorrow knock at our doors more loudly than pleasure and happiness; and the prints of their heavy footsteps are less easily effaced. Before the grim realities of practical life the pleasant fictions of optimism vanished. If this were the best of all possible worlds, it nevertheless proved itself a very inconvenient habitation for the ideal sage.

The stoical summary of the whole duty of man, 'Live according to nature,' would seem to imply that the cosmic process is an exemplar for human [74] conduct. Ethics would thus become applied Natural History. In fact, a confused employment of the maxim, in this sense, has done immeasurable mischief in later times. It has furnished an axiomatic foundation for the philosophy of philosophasters and for the moralizing of sentimentalists. But the Stoics were, at bottom, not merely noble, but sane, men; and if we look closely into what they really meant by this ill-used phrase, it will be found to present no justification for the mischievous conclusions that have been deduced from it.

In the language of the Stoa, 'Nature' was a word of many meanings. There was the 'Nature' of the cosmos and the 'Nature' of man. In the latter, the animal 'nature,' which man shares with a moiety of the living part of the cosmos, was distinguished from a higher 'nature.' Even in this higher nature there were grades of rank. The logical faculty is an instrument which may be turned to account for any purpose. The passions and the emotions are so closely tied to the lower nature that they may be considered to be pathological, rather than normal, phenomena. The one supreme, hegemonic, faculty, which constitutes the essential 'nature' of man, is most nearly represented by that which, in the language of a later philosophy, has been called the pure reason. It is this 'nature' which holds up the ideal of the supreme good and demands absolute submission of [75] the will to its behests. It is this which commands all men to love one another, to return good for evil, to regard one another as fellow-citizens of one great state. Indeed, seeing that the progress towards perfection of a civilized state, or polity, depends on the obedience of its members to these commands, the Stoics sometimes termed the pure reason the 'political' nature. Unfortunately, the sense of the adjective has undergone so much modification, that the application of it to that which commands the sacrifice of self to the common good would now sound almost grotesque.[15]

But what part is played by the theory of evolution in this view of ethics? So far as I can discern, the ethical system of the Stoics, which is essentially intuitive, and reverences the categorical imperative as strongly as that of any later moralists, might have been just what it was if they had held any other theory; whether that of special creation, on the one side, or that of the eternal existence of the present order, on the other.[16] To the Stoic, the cosmos had no importance for the conscience, except in so far as he chose to think it a pedagogue to virtue. The pertinacious optimism of our philosophers hid from them the actual state of the case. It prevented them from seeing that cosmic nature is no school of virtue, but the headquarters of the enemy of ethical nature. The logic of facts was necessary to convince them [76] that the cosmos works through the lower nature of man, not for righteousness, but against it. And it finally drove them to confess that the existence of their ideal "wise man" was incompatible with the nature of things; that even a passable approximation to that ideal was to be attained only at the cost of renunciation of the world and mortification, not merely of the flesh, but of all human affections. The state of perfection was that 'apatheia'[17] in which desire, though it may still be felt, is powerless to move the will, reduced to the sole function of executing the commands of pure reason. Even this residuum of activity was to be regarded as a temporary loan, as an efflux of the divine world-pervading spirit, chafing at its imprisonment in the flesh, until such time as death enabled it to return to its source in the all-pervading logos.

I find it difficult to discover any very great difference between Apatheia and Nirvana, except that stoical speculation agrees with pre-Buddhistic philosophy, rather than with the teachings of Gautama, in so far as it postulates a permanent substance equivalent to 'Brahma' and 'Atman'; and that, in stoical practice, the adoption of the life of the mendicant cynic was held to be more a counsel of perfection than an indispensable condition of the higher life.

Thus the extremes touch. Greek thought and [77] Indian thought set out from ground common to both, diverge widely, develop under very different physical and moral conditions, and finally converge to practically the same end.

The Vedas and the Homeric epos set before us a world of rich and vigorous life, full of joyous fighting men

> "That ever with a frolic welcome took
> The thunder and the sunshine ...."

and who were ready to brave the very Gods themselves when their blood was up. A few centuries pass away, and under the influence of civilization the descendants of these men are 'sicklied o'er with the pale cast of thought'–frank pessimists, or, at best, make-believe optimists. The courage of the warlike stock may be as hardly tried as before, perhaps more hardly, but the enemy is self. The hero has become a monk. The man of action is replaced by the quietist, whose highest aspiration is to be the passive instrument of the divine Reason. By the Tiber, as by the Ganges, ethical man admits that the cosmos is too strong for him; and, destroying every bond which ties him to it by ascetic discipline, he seeks salvation in absolute renunciation.[18]

Modern thought is making a fresh start from the base whence Indian and Greek philosophy set out; and, the human mind being very much what [78] it was six-and-twenty centuries ago, there is no ground for wonder if it presents indications of a tendency to move along the old lines to the same results.

We are more than sufficiently familiar with modern pessimism, at least as a speculation; for I cannot call to mind that any of its present votaries have sealed their faith by assuming the rags and the bowl of the mendicant Bhikku, or the cloak and the wallet of the Cynic. The obstacles placed in the way of sturdy vagrancy by an unphilosophical police have, perhaps, proved too formidable for philosophical consistency. We also know modern speculative optimism, with its perfectibility of the species, reign of peace, and lion and lamb transformation scenes; but one does not hear so much of it as one did forty years ago; indeed, I imagine it is to be met with more commonly at the tables of the healthy and wealthy, than in the congregations of the wise. The majority of us, I apprehend, profess neither pessimism nor optimism. We hold that the world is neither so good, nor so bad, as it conceivably might be; and, as most of us have reason, now and again, to discover that it can be. Those who have failed to experience the joys that make life worth living are, probably, in as small a minority as those who have never known the griefs that rob existence of its savour and turn its richest fruits into mere dust and ashes.

[79] Further, I think I do not err in assuming that, however diverse their views on philosophical and religious matters, most men are agreed that the proportion of good and evil in life may be very sensibly affected by human action. I never heard anybody doubt that the evil may be thus increased, or diminished; and it would seem to follow that good must be similarly susceptible of addition or subtraction. Finally, to my knowledge, nobody professes to doubt that, so far forth as we possess a power of bettering things, it is our paramount duty to use it and to train all our intellect and energy to this supreme service of our kind.

Hence the pressing interest of the question, to what extent modern progress in natural knowledge, and, more especially, the general outcome of that progress in the doctrine of evolution, is competent to help us in the great work of helping one another?

The propounders of what are called the "ethics of evolution," when the 'evolution of ethics' would usually better express the object of their speculations, adduce a number of more or less interesting facts and more or less sound arguments in favour of the origin of the moral sentiments, in the same way as other natural phenomena, by a process of evolution. I have little doubt, for my own part, that they are on the right track; but as the immoral sentiments have no less been evolved, there is, so far, as much natural sanction for the [80] one as the other. The thief and the murderer follow nature just as much as the philanthropist. Cosmic evolution may teach us how the good and the evil tendencies of man may have come about; but, in itself, it is incompetent to furnish any better reason why what we call good is preferable to what we call evil than we had before. Some day, I doubt not, we shall arrive at an understanding of the evolution of the æsthetic faculty; but all the understanding in the world will neither increase nor diminish the force of the intuition that this is beautiful and that is ugly.

There is another fallacy which appears to me to pervade the so-called "ethics of evolution." It is the notion that because, on the whole, animals and plants have advanced in perfection of organization by means of the struggle for existence and the consequent 'survival of the fittest'; therefore men in society, men as ethical beings, must look to the same process to help them towards perfection. I suspect that this fallacy has arisen out of the unfortunate ambiguity of the phrase 'survival of the fittest.' 'Fittest' has a connotation of 'best'; and about 'best' there hangs a moral flavour. In cosmic nature, however, what is 'fittest' depends upon the conditions. Long since,[19] I ventured to point out that if our hemisphere were to cool again, the survival of the fittest might bring about, in the vegetable kingdom, a population of more and more stunted and humbler and [81] humbler organisms, until the 'fittest' that survived might be nothing but lichens, diatoms, and such microscopic organisms as those which give red snow its colour; while, if it became hotter, the pleasant valleys of the Thames and Isis might be uninhabitable by any animated beings save those that flourish in a tropical jungle. They, as the fittest, the best adapted to the changed conditions, would survive.

Men in society are undoubtedly subject to the cosmic process. As among other animals, multiplication goes on without cessation, and involves severe competition for the means of support. The struggle for existence tends to eliminate those less fitted to adapt themselves to the circumstances of their existence. The strongest, the most self-assertive, tend to tread down the weaker. But the influence of the cosmic process on the evolution of society is the greater the more rudimentary its civilization. Social progress means a checking of the cosmic process at every step and the substitution for it of another, which may be called the ethical process; the end of which is not the survival of those who may happen to be the fittest, in respect of the whole of the conditions which obtain, but of those who are ethically the best.[20]

As I have already urged, the practice of that which is ethically best–what we call goodness or virtue–involves a course of conduct which, in all [82] respects, is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competitors, it requires that the individual shall not merely respect, but shall help his fellows; its influence is directed, not so much to the survival of the fittest, as to the fitting of as many as possible to survive. It repudiates the gladiatorial theory of existence. It demands that each man who enters into the enjoyment of the advantages of a polity shall be mindful of his debt to those who have laboriously constructed it; and shall take heed that no act of his weakens the fabric in which he has been permitted to live. Laws and moral precepts are directed to the end of curbing the cosmic process and reminding the individual of his duty to the community, to the protection and influence of which he owes, if not existence itself, at least the life of something better than a brutal savage.

It is from neglect of these plain considerations that the fanatical individualism[21] of our time attempts to apply the analogy of cosmic nature to society. Once more we have a misapplication of the stoical injunction to follow nature; the duties of the individual to the state are forgotten, and his tendencies to self-assertion are dignified by the name of rights. It is seriously debated whether the members of a community are justified in [83] using their combined strength to constrain one of their number to contribute his share to the maintenance of it; or even to prevent him from doing his best to destroy it.

The struggle for existence, which has done such admirable work in cosmic nature, must, it appears, be equally beneficent in the ethical sphere. Yet if that which I have insisted upon is true; if the cosmic process has no sort of relation to moral ends; if the imitation of it by man is inconsistent with the first principles of ethics; what becomes of this surprising theory?

Let us understand, once for all, that the ethical progress of society depends, not on imitating the cosmic process, still less in running away from it, but in combating it. It may seem an audacious proposal thus to pit the microcosm against the macrocosm and to set man to subdue nature to his higher ends; but I venture to think that the great intellectual difference between the ancient times with which we have been occupied and our day, lies in the solid foundation we have acquired for the hope that such an enterprise may meet with a certain measure of success.

The history of civilization details the steps by which men have succeeded in building up an artificial world within the cosmos. Fragile reed as he may be, man, as Pascal says, is a thinking reed.[22] there lies within him a fund of energy, operating intelligently and so far akin to that which pervades the universe, that it is competent [84] to influence and modify the cosmic process. In virtue of his intelligence, the dwarf bends the Titan to his will. In every family, in every polity that has been established, the cosmic process in man has been restrained and otherwise modified by law and custom; in surrounding nature, it has been similarly influenced by the art of the shepherd, the agriculturist, the artisan. As civilization has advanced, so has the extent of this interference increased; until the organized and highly developed sciences and arts of the present day have endowed man with a command over the course of non-human nature greater than that once attributed to the magicians. The most impressive, I might say startling, of these changes have been brought about in the course of the last two centuries; while a right comprehension of the process of life and of the means of influencing its manifestations is only just dawning upon us. We do not yet see our way beyond generalities and we are befogged by the obtrusion of false analogies and crude anticipations. But Astronomy, Physics, Chemistry, have all had to pass through similar phases, before they reached the stage at which their influence became an important factor in human affairs. Physiology, Psychology, Ethics, Political Science, must submit to the same ordeal. Yet it seems to me irrational to doubt that, at no distant period, they will work as great a revolution in the sphere of practice.

[85] The theory of evolution encourages no millennial anticipations. If, for millions of years, our globe has taken the upward road, yet, some time, the summit will be reached and the downward route will be commenced. The most daring imagination will hardly venture upon the suggestion that the power and the intelligence of man can ever arrest the procession of the great year.

Moreover, the cosmic nature born with us and, to a large extent, necessary for our maintenance, is the outcome of millions of years of severe training, and it would be folly to imagine that a few centuries will suffice to subdue its masterfulness to purely ethical ends. Ethical nature may count upon having to reckon with a tenacious and powerful enemy as long as the world lasts. But, on the other hand, I see no limit to the extent to which intelligence and will, guided by sound principles of investigation, and organized in common effort, may modify the conditions of existence, for a period longer than that now

covered by history. And much may be done to change the nature of man himself.[23] The intelligence which has converted the brother of the wolf into the faithful guardian of the flock ought to be able to do something towards curbing the instincts of savagery in civilized men.

But if we may permit ourselves a larger hope of abatement of the essential evil of the world than was possible to those who, in the infancy of exact [86] knowledge, faced the problem of existence more than a score of centuries ago, I deem it an essential condition of the realization of that hope that we should cast aside the notion that the escape from pain and sorrow is the proper object of life.

We have long since emerged from the heroic childhood of our race, when good and evil could be met with the same 'frolic welcome'; the attempts to escape from evil, whether Indian or Greek, have ended in flight from the battle-field; it remains to us to throw aside the youthful overconfidence and the no less youthful discouragement of nonage. We are grown men, and must play the man

> " strong in will
> To strive, to seek, to find, and not to yield,"

cherishing the good that falls in our way, and bearing the evil, in and around us, with stout hearts set on diminishing it. So far, we all may strive in one faith towards one hope:

> "It may be that the gulfs will wash us down,
> It may be we shall touch the Happy Isles,
> ... but something ere the end,
> Some work of noble note may yet be done."[24]

[87] NOTES

Note 1 (p. 49).

I have been careful to speak of the "appearance" of cyclical evolution presented by living things; for, on critical examination, it will be found that the course of vegetable and of animal life is not exactly represented by the figure of a cycle which returns into itself. What actually happens, in all but the lowest organisms, is that one part of the growing germ (*A*) gives rise to tissues and organs; while another part (*B*) remains in its primitive condition, or is but slightly modified. The moiety *A* becomes the body of the adult and, sooner or later, perishes, while portions of the moiety *B* are detached and, as offspring, continue the life of the species. Thus, if we trace back an organism along the direct line of descent from its remotest ancestor, *B*, as a whole, has never suffered death; portions of it, only, have been cast off and died in each individual offspring.

Everybody is familiar with the way in which the "suckers" of a strawberry plant behave. A thin cylinder of living tissue keeps on growing at its free end, until it attains a considerable length. At [88] successive intervals, it develops buds which grow into strawberry plants; and these become independent by the death of the parts of the sucker which connect them. The rest of the sucker, however, may go on living and growing indefinitely, and,

circumstances remaining favourable, there is no obvious reason why it should ever die. The living substance *B*, in a manner, answers to the sucker. If we could restore the continuity which was once possessed by the portions of *B*, contained in all the individuals of a direct line of descent, they would form a sucker, or *stolon*, on which these individuals would be strung, and which would never have wholly died.

A species remains unchanged so long as the potentiality of development resident in *B* remains unaltered; so long, *e.g.*, as the buds of the strawberry sucker tend to become typical strawberry plants. In the case of the progressive evolution of a species, the developmental potentiality of *B* becomes of a higher and higher order. In retrogressive evolution, the contrary would be the case. The phenomena of atavism seem to show that retrogressive evolution, that is, the return of a species to one or other of its earlier forms, is a possibility to be reckoned with. The simplification of structure, which is so common in the parasitic members of a group, however, does not properly come under this head. The worm-like, limbless *Lernæa* has no resemblance to any of the stages of development of the many-limbed active animals of the group to which it belongs.

[89] *Note* 2 (p. 49).

Heracleitus says, Ηοταμω γαρ ουκ εστι δισ εμβηναι το αντω; but, to be strictly accurate, the river remains, though the water of which it is composed changes–just as a man retains his identity though the whole substance of his body is constantly shifting.

This is put very well by Seneca (Ep. Ivii. i. 20, Ed. Ruhkopf): "Corpora nostra rapiuntur fluminum more, quidquid vides currit cum tempore; nihil ex his quæ videmus manet. Ego ipse dum loquor mutari ista, mutatus sum. Hoc est quod ait Heraclitus 'In idem flumen bis non descendimus.' Manet idem fluminis nomen, aqua transmissa est. Hoc in amne manifestius est quam in homine, sed nos quoque non minus velox cursus prætervehit."

Note 3 (p. 55).

"Multa bona nostra nobis nocent, timoris enim tormentum memoria reducit, providentia anticipat. Nemo tantum præsentibus miser est." (Seneca, Ed. v. 7.)

Among the many wise and weighty aphorisms of the Roman Bacon, few sound the realities of life more deeply than "Multa bona nostra nobis nocent." If there is a soul of good in things evil, it is at least equally true that there is a soul of evil in things good: for things, like men, have "les defauts de leurs qualites." It is one of the last lessons one learns from experience, but not the least important, that a [90] heavy tax is levied upon all forms of success; and that failure is one of the commonest disguises assumed by blessings.

Note 4 (p. 60).

"There is within the body of every man a soul which, at the death of the body, flies away from it like a bird out of a cage, and enters upon a new life . . . either in one of the heavens or one of the hells or on this earth. The only exception is the rare case of a man having in this life acquired a true knowledge of God. According to the pre-Buddhistic theory, the soul of such a man goes along the path of the Gods to God, and, being united with Him, enters upon an immortal life in which his individuality is not extinguished. In the latter theory, his soul is directly

absorbed into the Great Soul, is lost in it, and has no longer any independent existence. The souls of all other men enter, after the death of the body, upon a new existence in one or other of the many different modes of being. If in heaven or hell, the soul itself becomes a god or demon without entering a body; all superhuman beings, save the great gods, being looked upon as not eternal, but merely temporary creatures. If the soul returns to earth it may or may not enter a new body; and this either of a human being, an animal, a plant, or even a material object. For all these are possessed of souls, and there is no essential difference between these souls and the souls of men–all being alike mere sparks of the Great Spirit, who is the only real [91] existence." (Rhys Davids, *Hibbert Lectures*, 1881, p. 83.)

For what I have said about Indian Philosophy, I am particularly indebted to the luminous exposition of primitive Buddhism and its relations to earlier Hindu thought, which is given by Prof. Rhys Davids in his remarkable *Hibbert Lectures* for 1881, and *Buddhism* (1890). The only apology I can offer for the freedom with which I have borrowed from him in these notes, is my desire to leave no doubt as to my indebtedness. I have also found Dr. Oldenberg's *Buddha* (Ed. 2, 1890) very helpful. The origin of the theory of transmigration stated in the above extract is an unsolved problem. That it differs widely from the Egyptian metempsychosis is clear. In fact, since men usually people the other world with phantoms of this, the Egyptian doctrine would seem to presuppose the Indian as a more archaic belief.

Prof. Rhys Davids has fully insisted upon the ethical importance of the transmigration theory. "One of the latest speculations now being put forward among ourselves would seek to explain each man's character, and even his outward condition in life, by the character he inherited from his ancestors, a character gradually formed during a practically endless series of past existences, modified only by the conditions into which he was born, those very conditions being also, in like manner, the last result of a practically endless series of past causes. Gotama's speculation might be stated in the same words. But it attempted also to explain, in a way different from [92] that which would be adopted by the exponents of the modern theory, that strange problem which it is also the motive of the wonderful drama of the book of Job to explain–the fact that the actual distribution here of good fortune, or misery, is entirely independent of the moral qualities which men call good or bad. We cannot wonder that a teacher, whose whole system was so essentially an ethical reformation, should have felt it incumbent upon him to seek an explanation of this apparent injustice. And all the more so, since the belief he had inherited, the theory of the transmigration of souls, had provided a solution perfectly sufficient to any one who could accept that belief." (*Hibbert Lectures*, p. 93.) I should venture to suggest the substitution of 'largely' for 'entirely' in the foregoing passage. Whether a ship makes a good or a bad voyage is largely independent of the conduct of the captain, but it is largely affected by that conduct. Though powerless before a hurricane he may weather many a bad gale.

Note 5 (p. 61).

The outward condition of the soul is, in each new birth, determined by its actions in a previous birth; but by each action in succession, and not by the balance struck after the evil has been reckoned off against the good. A good man who has once uttered a slander may spend a hundred thousand years as a god, in consequence of his goodness, and when the power of his good actions is exhausted, may be born [93] as a dumb man on account of his transgression; and a robber who has once done an act of mercy, may come to life in a king's body as the result of his virtue, and then suffer torments for ages in hell or as a ghost without a body, or be re-born many times as a slave or an outcast, in consequence of his evil life.

"There is no escape, according to this theory, from the result of any act; though it is only the consequences of its own acts that each soul has to endure. The force has been set in motion by itself and can never stop; and its effect can never be foretold. If evil, it can never be modified or prevented, for it depends on a cause already completed, that is now for ever beyond the soul's control. There is even no continuing consciousness, no memory of the past that could guide the soul to any knowledge of its fate. The only advantage open to it is to add in this life to the sum of its good actions, that it may bear fruit with the rest. And even this can only happen in some future life under essentially the same conditions as the present one: subject, like the present one, to old age, decay, and death; and affording opportunity, like the present one, for the commission of errors, ignorances, or sins, which in their turn must inevitably produce their due effect of sickness, disability, or woe. Thus is the soul tossed about from life to life, from billow to billow in the great ocean of transmigration. And there is no escape save for the very few, who, during their birth as men, attain to a right knowledge of the great Spirit: and thus enter into immortality, or, as the later philosophers taught, are absorbed into the [904] Divine Essence." (Rhys Davids, *Hibbert Lectures,* pp. 85, 86.)

The state after death thus imagined by the Hindu philosophers has a certain analogy to the purgatory of the Roman Church; except that escape from it is dependent, not on a divine decree modified, it may be, by sacerdotal or saintly intercession, but by the acts of the individual himself; and that while ultimate emergence into heavenly bliss of the good, or well-prayed for, Catholic is professedly assured, the chances in favour of the attainment of absorption, or of Nirvana, by any individual Hindu are extremely small.

Note 6 (p. 62).

"That part of the then prevalent transmigration theory which could not be proved false seemed to meet a deeply felt necessity, seemed to supply a moral cause which would explain the unequal distribution here of happiness or woe, so utterly inconsistent with the present characters of men." Gautama "still therefore talked of men's previous existence, but by no means in the way that he is generally represented to have done." What he taught was "the transmigration of character." He held that after the death of any being, whether human or not, there survived nothing at all but that being's 'Karma,' the result, that is, of its mental and bodily actions. Every individual, whether human or divine, was the last inheritor and the last result of the Karma of a long series of past individuals–a series [95] so long that its beginning is beyond the reach of calculation, and its end will be coincident with the destruction of the world." (Rhys Davids, *Hibbert Lectures,* p. 92.)

In the theory of evolution, the tendency of a germ to develop according to a certain specific type, *e.g.* of the kidney bean seed to grow into a plant having all the characters of *Phaseolus vulgaris,* is its 'Karma.' It is the "last inheritor and the last result" of all the conditions that have affected a line of ancestry which goes back for many millions of years to the time when life first appeared on the earth. The moiety B of the substance of the bean plant (see Note 1) is the last link in a once continuous chain extending from the primitive living substance: and the characters of the successive species to which it has given rise are the manifestations of its gradually modified Karma. As Prof. Rhys Davids aptly says, the snowdrop "is a snowdrop and not an oak, and just that kind of snowdrop, because it is the outcome of the Karma of an endless series of past existences." (*Hibbert Lectures,* p. 114.)

Note 7 (p. 64).

"It is interesting to notice that the very point which is the weakness of the theory–the supposed concentration of

the effect of the Karma in one new being–presented itself to the early Buddhists themselves as a difficulty. They avoided it, partly by explaining that it was a particular thirst in the creature dying (a craving, Tanha, which plays other[96]wise a great part in the Buddhist theory) which actually caused the birth of the new individual who was to inherit the Karma of the former one. But, how this took place, how the craving desire produced this effect, was acknowledged to be a mystery patent only to a Buddha." (Rhys Davids, *Hibbert Lectures*, p. 95.)

Among the many parallelisms of Stoicism and Buddhism, it is curious to find one for this Tanha, 'thirst,' or 'craving desire' for life. Seneca writes (Epist. lxxvi. 18): "Si enim ullum aliud est bonum quam honestum, sequetur nos *aviditas vitæ* aviditas rerum vitam instruentium: quod est intolerabile infinitum, vagum."

Note 8 (p. 66).

"The distinguishing characteristic of Buddhism was that it started a new line, that it looked upon the deepest questions men have to solve from an entirely different standpoint. It swept away from the field of its vision the whole of the great soul-theory which had hitherto so completely filled and dominated the minds of the superstitious and the thoughtful alike. For the first time in the history of the world, it proclaimed a salvation which each man could gain for himself and by himself, in this world, during this life, without any the least reference to God, or to Gods, either great or small. Like the Upanishads, it placed the first importance on knowledge; but it was no longer a knowledge of God, it was a clear perception of the real nature, as they [97] supposed it to be, of men and things. And it added to the necessity of knowledge, the necessity of purity, of courtesy, of uprightness, of peace and of a universal love far reaching, grown great and beyond measure." (Rhys Davids, *Hibbert Lectures*, p. 29.)

The contemporary Greek philosophy takes an analogous direction. According to Heracleitus, the universe was made neither by Gods nor men; but, from all eternity, has been, and to all eternity, will be, immortal fire, glowing and fading in due measure. (Mullach, *Heracleiti Fragmenta*, 27.) And the part assigned by his successors, the Stoics, to the knowledge and the volition of the 'wise man' made their Divinity (for logical thinkers) a subject for compliments, rather than a power to be reckoned with. In Hindu speculation the 'Arahat,' still more the 'Buddha,' becomes the superior of Brahma; the stoical 'wise man' is, at least, the equal of Zeus.

Berkeley affirms over and over again that no idea can be formed of a soul or spirit–"If any man shall doubt of the truth of what is here delivered, let him but reflect and try if he can form any idea of power or active being; and whether he hath ideas of two principal powers marked by the names of *will* and *understanding* distinct from each other, as well as from a third idea of substance or being in general, with a relative notion of its supporting or being the subject of the aforesaid power, which is signified by the name *soul* or *spirit.* This is what some hold: but, so far as I can see, the words *will, soul, spirit,* [98] do not stand for different ideas or, in truth, for any idea at all, but for something which is very different from ideas, and which, being an agent, cannot be like unto or represented by any idea whatever [though it must be owned at the same time, that we have some notion of soul, spirit, and the operations of the mind, such as willing, loving, hating, inasmuch as we know or understand the meaning of these words"]. (*The Principles of Human Knowledge*, lxxvi. See also §§ lxxxix., cxxxv., cxlv.)

It is open to discussion, I think, whether it is possible to have 'some notion' of that of which we can form no 'idea.'

Berkeley attaches several predicates to the "perceiving active being mind, spirit, soul or myself" (Parts I. II.). It is said, for example, to be "indivisible, incorporeal, unextended, and incorruptible." The predicate indivisible,

though negative in form, has highly positive consequences. For, if 'perceiving active being' is strictly indivisible, man's soul must be one with the Divine spirit: which is good Hindu or Stoical doctrine, but hardly orthodox Christian philosophy. If, on the other hand, the 'substance' of active perceiving 'being' is actually divided into the one Divine and innumerable human entities, how can the predicate 'indivisible' be rigorously applicable to it?

Taking the words cited, as they stand, they amount to the denial of the possibility of any knowledge of substance. 'Matter' having been resolved into mere affections of 'spirit,' 'spirit' melts away into an admittedly inconceivable and unknowable hypostasis [99] of thought and power–consequently the existence of anything in the universe beyond a flow of phenomena is a purely hypothetical assumption. Indeed a pyrrhonist might raise the objection that if 'esse' is 'percipi' spirit itself can have no existence except as a perception, hypostatized into a 'self,' or as a perception of some other spirit. In the former case, objective reality vanishes; in the latter, there would seem to be the need of an innate series of spirits each perceiving the others.

It is curious to observe how very closely the phraseology of Berkeley sometimes approaches that of the Stoics:: thus (cxlviii.) "It seems to be a *general pretense of the unthinking* herd that *they cannot see God*.....But, alas, we need only open our eyes to see the Sovereign Lord of all things with a more full and clear view, than we do any of our fellow-creatures... we do at all times and in all places perceive manifest tokens of the Divinity: everything we see, hear, feel, or any wise perceive by sense, being a sign or effect of the power of God "..... cxlix. "It is therefore plain, that *nothing can be more evident* to any one that is capable of the least reflection, *than the existence of God*, or a spirit who is intimately present to our minds, producing in them all that variety of ideas or sensations which continually affect us, on whom we have an absolute and entire dependence, in short, in whom *we live and move and have our being.*" cl. [But you will say hath Nature no share in the production of natural things, and must they be all ascribed to the immediate and sole operation of God? .....if by *Nature* is meant some [100] being distinct from God, as well as from the laws of nature and things perceived by sense, I must confess that word is to me an empty sound, without any intelligible meaning annexed to it.] Nature in this acceptation is a vain *Chimæra* introduced by those heathens, who had not just notions of the omnipresence and infinite perfection of God."

Compare Seneca (*De Beneficiis*, iv. 7):

"Natura, inquit, hæc mihi præstat. Non intelligis te, quum hoc dicis, mutare Nomen Deo? Quid enim est aliud Natura quam Deus, et divina ratio, toti mundo et partibus ejus inserta? Quoties voles tibi licet aliter hunc auctorem rerum nostrarum compellare, et Jovem illum optimum et maximum rite dices, et tonantem, et statorem: qui non, ut historici tradiderunt, ex eo quod post votum susceptum acies Romanorum fugientum stetit, sed quod stant beneficio ejus omnia, stator, stabilitorque est: hunc eundem et fatum si dixeris, non mentieris, nam quum fatum nihil aliud est, quam series implexa causarum, ille est prima omnium causa, ea qua cæteræ pendent." It would appear, therefore, that the good Bishop is somewhat hard upon the 'heathen,' of whose words his own might be a paraphrase.

There is yet another direction in which Berkeley's philosophy, I will not say agrees with Gautama's, but at any rate helps to make a fundamental dogma of Buddhism intelligible.

"I find I can excite ideas in my mind at pleasure, and vary and shift the scene as often as I think fit. It is no more than willing, and straightway this or that idea arises in my fancy:and by the same power, [101] it is obliterated, and makes way for another. This making and unmaking of ideas doth very properly denominate the mind active.

This much is certain and grounded on experience...." (*Principles,* xxviii.)

A good many of us, I fancy, have reason to think that experience tells them very much the contrary; and are painfully familiar with the obsession of the mind by ideas which cannot be obliterated by any effort of the will and steadily refuse to make way for others. But what I desire to point out is that if Gautama was equally confident that he could 'make and unmake' ideas–then, since he had resolved self into a group of ideal phantoms–the possibility of abolishing self by volition naturally followed.

Note 9 (p. 68).

According to Buddhism, the relation of one life to the next is merely that borne by the flame of one lamp to the same of another lamp which is set alight by it. To the 'Arahat' or adept "no outward form, no compound thing, no creature, no creator, no existence of any kind, must appear to be other than a temporary collocation of its component parts, fated inevitably to be dissolved."–(Rhys Davids, *Hibbert Lectures,* p. 211.)

The self is nothing but a group of phenomena held together by the desire of life; when that desire shall have ceased, "the Karma of that particular chain of lives will cease to influence any longer any distinct individual, and there will be no more birth; for [102] birth, decay, and death, grief, lamentation, and despair will have come, so far as regards that chain of lives, for ever to an end."

The state of mind of the Arahat in which the desire of life has ceased is Nirvana. Dr. Oldenberg has very acutely and patiently considered the various interpretations which have been attached to 'Nirvana 'in the work to which I have referred (pp. 285 *et seq.*). The result of his and other discussions of the question may I think be briefly stated thus:

1. Logical deduction from the predicates attached to the term 'Nirvana' strips it of all reality, conceivability, or perceivability, whether by Gods or men. For all practical purposes, therefore, it comes to exactly the same thing as annihilation.

2. But it is not annihilation in the ordinary sense, inasmuch as it could take place in the living Arahat or Buddha.

3. And, since, for the faithful Buddhist, that which was abolished in the Arahat was the possibility of further pain, sorrow, or sin; and that which was attained was perfect peace; his mind directed itself exclusively to this joyful consummation, and personified the negation of all conceivable existence and of all pain into a positive bliss. This was all the more easy, as Gautama refused to give any dogmatic definition of Nirvana. There is something analogous in the way in which people commonly talk of the 'happy release' of a man who has been long suffering from mortal disease. According to their own views, it must always be extremely doubtful whether the man will be any happier after the 'release' than [103] before. But they do not choose to look at the matter in this light.

The popular notion that, with practical, if not metaphysical, annihilation in view, Buddhism must needs be a sad and gloomy faith seems to be inconsistent with fact; on the contrary, the prospect of Nirvana fills the true believer, not merely with cheerfulness, but with an ecstatic desire to reach it.

Note 10 (p. 68).

The influence of the picture of the personal qualities of Gautama, afforded by the legendary anecdotes which rapidly grew into a biography of the Buddha; and by the birth stories, which coalesced with the current folklore, and were intelligible to all the world, doubtless played a great part. Further, although Gautama appears not to have meddled with the caste system, he refused to recognize any distinction, save that of perfection in the way of salvation, among his followers; and by such teaching, no less than by the inculcation of love and benevolence to all sentient beings, he practically levelled every social, political, and racial barrier. A third important condition was the organization of the Buddhists into monastic communities for the stricter professors, while the laity were permitted a wide indulgence in practice and were allowed to hope for accommodation in some of the temporary abodes of bliss. With a few hundred thousand years of immediate paradise in sight, the average man could be content to shut his eyes to what might follow.

[104] *Note* 11 (p. 69).

In ancient times it was the fashion, even among the Greeks themselves, to derive all Greek wisdom from Eastern sources; not long ago it was as generally denied that Greek philosophy had any connection with Oriental speculation; it seems probable, however, that the truth lies between these extremes.

The Ionian intellectual movement does not stand alone. It is only one of several sporadic indications of the working of some powerful mental ferment over the whole of the area comprised between the Ægean and Northern Hindostan during the eighth, seventh, and sixth centuries before our era. In these three hundred years, prophetism attained its apogee among the Semites of Palestine; Zoroasterism grew and became the creed of a conquering race, the Iranic Aryans; Buddhism rose and spread with marvellous rapidity among the Aryans of Hindostan; while scientific naturalism took its rise among the Aryans of Ionia. It would be difficult to find another three centuries which have given birth to four events of equal importance. All the principal existing religions of mankind have grown out of the first three: while the fourth is the little spring, now swollen into the great stream of positive science. So far as physical possibilities go, the prophet Jeremiah and the oldest Ionian philosopher might have met and conversed. If they had done so, they would probably have disagreed a good deal; and it is interesting to reflect that their discussions might have [105] embraced questions which, at the present day, are still hotly controverted.

The old Ionian philosophy, then, seems to be only one of many results of a stirring of the moral and intellectual life of the Aryan and the Semitic populations of Western Asia. The conditions of this general awakening were doubtless manifold; but there is one which modern research has brought into great prominence. This is the existence of extremely ancient and highly advanced societies in the valleys of the Euphrates and of the Nile.

It is now known that, more than a thousand–perhaps more than two thousand–years before the sixth century B.C., civilization had attained a relatively high pitch among the Babylonians and the Egyptians. Not only had painting, sculpture, architecture, and the industrial arts reached a remarkable development; but in Chaldlæa, at any rate, a vast amount of knowledge had been accumulated and methodized, in the departments of grammar, mathematics, astronomy, and natural history. Where such traces of the scientific spirit are visible, naturalistic speculation is rarely far off, though, so far as I know, no remains of an Accadian, or Egyptian, philosophy, properly so called, have yet been recovered.

Geographically, Chaldæa occupied a central position among the oldest seats of civilization. Commerce, largely aided by the intervention of those colossal pedlars, the Phœnicians, had brought Chaldæa into connection with all

of them, for a thousand years before the epoch at present under consideration. [106] And in the ninth, eighth, and seventh centuries, the Assyrian, the depositary of Chaldæan civilization, as the Macedonian and the Roman, at a later date, were the depositaries of Greek culture, had added irresistible force to the other agencies for the wide distribution of Chaldæan literature, art, and science.

I confess that I find it difficult to imagine that the Greek immigrants–who stood in somewhat the same relation to the Babylonians and the Egyptians as the later Germanic barbarians to the Romans of the Empire–should not have been immensely influenced by the new life with which they became acquainted. But there is abundant direct evidence of the magnitude of this influence in certain spheres. I suppose it is not doubted that the Greek went to school with the Oriental for his primary instruction in reading, writing, and arithmetic; and that Semitic theology supplied him with some of his mythological lore. Nor does there now seem to be any question about the large indebtedness of Greek art to that of Chaldæea and that of Egypt.

But the manner of that indebtedness is very instructive. The obligation is clear, but its limits are no less definite. Nothing better exemplifies the indomitable originality of the Greeks than the relations of their art to that of the Orientals. Far from being subdued into mere imitators by the technical excellence of their teachers, they lost no time in bettering the instruction they received, using their models as mere stepping stones on the way to those unsurpassed and unsurpassable achievements which are all their own. The shibboleth of Art is [107] the human figure. The ancient Chaldæans and Egyptians, like the modern Japanese, did wonders in the representation of birds and quadrupeds; they even attained to something more than respectability in human portraiture. But their utmost efforts never brought them within range of the best Greek embodiments of the grace of womanhood, or of the severer beauty of manhood.

It is worth while to consider the probable effect upon the acute and critical Greek mind of the conflict of ideas, social, political, and theological, which arose out of the conditions of life in the Asiatic colonies. The Ionian polities had passed through the whole gamut of social and political changes, from patriarchal and occasionally oppressive kingship to rowdy and still more burdensome mobship–no doubt with infinitely eloquent and copious argumentation, on both sides, at every stage of their progress towards that arbitrament of force which settles most political questions. The marvellous speculative faculty, latent in the Ionian, had come in contact with Mesopotamian, Egyptian, Phœnician theologies and cosmogonies; with the illuminati of Orphism and the fanatics and dreamers of the Mysteries; possibly with Buddhism and Zoroasterism; possibly even with Judaism. And it has been observed that the mutual contradictions of antagonistic supernaturalisms are apt to play a large part among the generative agencies of naturalism.

Thus, various external influences may have contributed to the rise of philosophy among the Ionian Greeks of the sixth century. But the assimilative [108] capacity of the Greek mind–its power of Hellenizing whatever it touched–has here worked so effectually, that, so far as I can learn, no indubitable traces of such extraneous contributions are now allowed to exist by the most authoritative historians of Philosophy. Nevertheless, I think it must be admitted that the coincidences between the Heracleito-stoical doctrines and those of the older Hindu philosophy are extremely remarkable. In both, the cosmos pursues an eternal succession of cyclical changes. The great year, answering to the Kalpa, covers an entire cycle from the origin of the universe as a fluid to its dissolution in fire–"Humor initium, ignis exitus mundi," as Seneca has it. In both systems, there is immanent in the cosmos a source of energy, Brahma, or the Logos, which works according to fixed laws. The individual soul is an efflux of this world-spirit, and returns to it. Perfection is attainable only by individual effort, through ascetic discipline, and is rather a state of painlessness than of happiness; if indeed it can be said to be a state of anything, save the negation of perturbing emotion. The hatchment motto "In Cœlo Quies" would serve both Hindu and

Stoic; and absolute quiet is not easily distinguishable from annihilation.

Zoroasterism, which, geographically, occupies a position intermediate between Hellenism and Hinduism, agrees with the latter in recognizing the essential evil of the cosmos; but differs from both in its intensely anthropomorphic personification of the two antagonistic principles, to the one of which it ascribes all the good; and, to the other, all the evil. [109] In fact, it assumes the existence of two worlds, one good and one bad; the latter created by the evil power for the purpose of damaging the former. The existing cosmos is a mere mixture of the two, and the 'last judgment' is a root-and-branch extirpation of the work of Ahriman.

Note 12 (p. 69).

There is no snare in which the feet of a modern student of ancient lore are more easily entangled, than that which is spread by the similarity of the language of antiquity to modern modes of expression. I do not presume to interpret the obscurest of Greek philosophers; all I wish is to point out, that his words, in the sense accepted by competent interpreters, fit modern ideas singularly well.

So far as the general theory of evolution goes there is no difficulty. The aphorism about the river; the figure of the child playing on the shore; the kingship and fatherhood of strife, seem decisive. The οδοσ ανω κατω μιη expresses with singular aptness, the cyclical aspect of the one process of organic evolution in individual plants and animals: yet it may be a question whether the Heracleitean strife included any distinct conception of the struggle for existence. Again, it is tempting to compare the part played by the Heracleitean 'fire' with that ascribed by the moderns to heat, or rather to that cause of motion of which heat is one expression; and a little ingenuity might find a foreshadowing of the doctrine of the conservation of energy, in the saying that all the [110] things are changed into fire and fire into all things, as gold into goods and goods into gold.

Note 13 (p. 71).

Pope's lines in the *Essay on Man* (Ep. i. 267-8),

> "All are but parts of one stupendous whole,
> Whose body Nature is, and God the soul."

simply paraphrase Seneca's "quem in hoc mundo locum deus obtinet, hunc in homine animus: quod est illic materia, id nobis corpus est." (Ep. 1xv. 24); which again is a Latin version of the old Stoical doctrine, εισ απαν του κοσμου μεροσ διηκει ο νουσ, καθαπερ αφ ημων η ψυξη.

So far as the testimony for the universality of what ordinary people call 'evil' goes, there is nothing better than the writings of the Stoics themselves. They might serve as a storehouse for the epigrams of the ultra-pessimists. Heracleitus (*circa* 500 B.C.) says just as hard things about ordinary humanity as his disciples centuries later; and there really seems no need to seek for the causes of this dark view of life in the circumstances of the time of Alexander's successors or of the early Emperors of Rome. To the man with an ethical ideal, the world, including himself, will always seem full of evil.

Note 14 (p. 73).

I use the well-known phrase, but decline responsibility for the libel upon Epicurus, whose doctrines were far less compatible with existence in a stye [111] than those of the Cynics. If it were steadily borne in mind that the conception of the 'flesh' as the source of evil, and the great saying 'Initium est salutis notitia peccati,' are the property of Epicurus, fewer illusions about Epicureanism would pass muster for accepted truth.

Note 15 (p. 75).

The Stoics said that man was ζωον λογικον πολιτικον φιλαλληλον, a rational, a political, and an altruistic or philanthropic animal. In their view, his higher nature tended to develop in these three directions, as a plant tends to grow up into its typical form. Since, without the introduction of any consideration of pleasure or pain, whatever thwarted the realization of its type by the plant might be said to be bad, and whatever helped it good; so virtue, in the Stoical sense, as the conduct which tended to the attainment of the rational, political, and philanthropic ideal, was good in itself, and irrespectively of its emotional concomitants.

Man is an "animal sociale communi bono genitum." The safety of society depends upon practical recognition of the fact. "Salva autem esse societas nisi custodia et amore partium non possit," says Seneca. (*De. Ira,* ii. 31.)

Note 16 (p. 75).

The importance of the physical doctrine of the Stoics lies in its clear recognition of the universality [112] of the law of causation, with its corollary, the order of nature: the exact form of that order is an altogether secondary consideration.

Many ingenious persons now appear to consider that the incompatibility of pantheism, of materialism, and of any doubt about the immortality of the soul, with religion and morality, is to be held as an axiomatic truth. I confess that I have a certain difficulty in accepting this dogma. For the Stoics were notoriously materialists and pantheists of the most extreme character; and while no strict Stoic believed in the eternal duration of the individual soul, some even denied its persistence after death. Yet it is equally certain that of all gentile philosophies, Stoicism exhibits the highest ethical development, is animated by the most religious spirit, and has exerted the profoundest influence upon the moral and religious development not merely of the best men among the Romans, but among the moderns down to our own day.

Seneca was claimed as a Christian and placed among the saints by the fathers of the early Christian Church; and the genuineness of a correspondence between him and the apostle Paul has been hotly maintained in our own time, by orthodox writers. That the letters, as we possess them, are worthless forgeries is obvious; and writers as wide apart as Baur and Lightfoot agree that the whole story is devoid of foundation.

The dissertation of the late Bishop of Durham (*Epistle to the Philippians)* is particularly worthy of study, apart from this question, on account of the [113] evidence which it supplies of the numerous similarities of thought between Seneca and the writer of the Pauline epistles. When it is remembered that the writer of the Acts puts a quotation from Aratus, or Cleanthes, into the mouth of the apostle; and that Tarsus was a great seat of philosophical and especially stoical learning (Chrysippus himself was a native of the adjacent town of Sôli), there is no difficulty in understanding the origin of these resemblances. See, on this subject, Sir Alexander Grant's dissertation in his edition of the *Ethics of Aristotle* (where there is an interesting reference to the stoical character

of Bishop Butler's ethics), the concluding pages of Dr. Weygoldt's instructive little work *Die Philosophie der Stoa,* and Aubertin's *Sénèque et Saint Paul.*

It is surprising that a writer of Dr. Lightfoot's stamp should speak of Stoicism as a philosophy of 'despair.' Surely, rather, it was a philosophy of men who, having cast off all illusions, and the childishness of despair among them, were minded to endure in patience whatever conditions the cosmic process might create, so long as those conditions were compatible with the progress towards virtue, which alone, for them, conferred a worthy object on existence. There is no note of despair in the stoical declaration that the perfected 'wise man' is the equal of Zeus in everything but the duration of his existence. And, in my judgment, there is as little pride about it, often as it serves for the text of discourses on stoical arrogance. Grant the stoical postulate that there is no good except virtue; grant that the per[114]fected wise man is altogether virtuous, in consequence of being guided in all things by the reason, which is an effluence of Zeus, and there seems no escape from the stoical conclusion.

Note 17 (p.76).

Our "Apathy" carries such a different set of connotations from its Greek original that I have ventured on using the latter as a technical term.

Note 18 (p. 80).

Many of the stoical philosophers recommended their disciples to take an active share in public affairs; and in the Roman world, for several centuries, the best public men were strongly inclined to Stoicism. Nevertheless, the logical tendency of Stoicism seems to me to be fulfilled only in such men as Diogenes and Epictetus.

Note 19 (p. 80).

"Criticisms on the Origin of Species," 1864. *Collected Essays*, vol. ii. p. 91. [1894.]

Note 20 (p. 81).

Of course, strictly speaking, social life, and the ethical process in virtue of which it advances towards perfection, are part and parcel of the general process of evolution, just as the gregarious habit of in[115]numerable plants and animals, which has been of immense advantage to them, is so. A hive of bees is an organic polity, a society in which the part played by each member is determined by organic necessities. Queens, workers, and drones are, so to speak, castes, divided from one another by marked physical barriers. Among birds and mammals, societies are formed, of which the bond in many cases seems to be purely psychological; that is to say, it appears to depend upon the liking of the individuals for one another's company. The tendency of individuals to over self-assertion is kept down by fighting. Even in these rudimentary forms of society, love and fear come into play, and enforce a greater or less renunciation of self-will. To this extent the general cosmic process begins to be checked by a rudimentary ethical process, which is, strictly speaking, part of the former, just as the 'governor' in a steam-engine is part of the mechanism of the engine.

Note 21 (p. 82).

See "Government: Anarchy or Regimentation," *Collected Essays,* vol. i. pp. 413–418. It is this form of political philosophy to which I conceive the epithet of 'reasoned savagery' to be strictly applicable. [1894.]

Note 22 (p. 83).

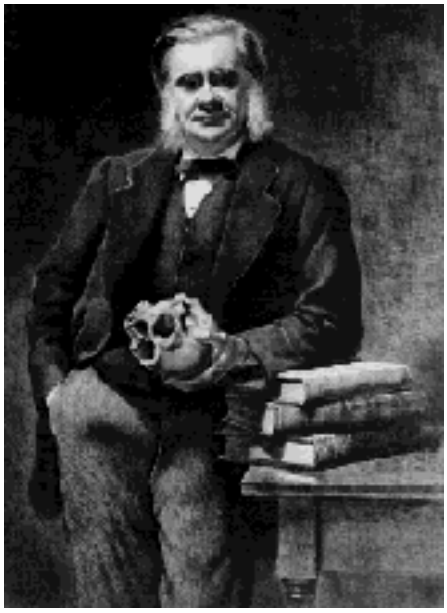
"L'homme n'est qu'un roseau, le plus faible de la nature, mais c'est un roseau pensant. Il ne faut [116] pas que l'univers entier s'arme pour l'écraser. Une vapeur, une goutte, d'eau, suffit pour le teur. Mais quand l'univers l'écraserait, l'homme serait encore plus noble que ce qui le tue, parce qu'il sait qu'il meurt; et l'avantage que l'univers a sur lui, I'univers n'en sait rien."–*Pensées de Pascal.*

Note 23 (p. 85).

The use of the word "Nature" here may be criticised. Yet the manifestation of the natural tendencies of men is so profoundly modified by training that it is hardly too strong. Consider the suppression of the sexual instinct between near relations.

Note 24 (p. 86).

A great proportion of poetry is addressed by the young to the young; only the great masters of the art are capable of divining, or think it worth while to enter into, the feelings of retrospective age. The two great poets whom we have so lately lost, Tennyson and Browning, have done this, each in his own inimitable way; the one in the *Ulysses,* from which I have borrowed; the other in that wonderful fragment 'Childe Roland to the dark Tower came.'



Science and Morals (1886)

Collected Essays IX

[117] In spite of long and, perhaps, not unjustifiable hesitation, I begin to think that there must be something in telepathy. For evidence, which I may not disregard, is furnished by the last number of the "Fortnightly Review" that among the hitherto undiscovered endowments of the human species, there may be a power even more wonderful than the mystic faculty by which the esoterically Buddhistic sage "upon the farthest mountain in Cathay" reads the inmost thoughts of a dweller within the homely circuit of the London postal district. Great indeed is the insight of such a seer; but how much greater is his who combines the feat of reading, not merely the thoughts of which the thinker is aware, but those of which he knows nothing; who sees him unconsciously drawing the conclusions which he repudiates, and [118] supporting the doctrines which he detests. To reflect upon the confusion which the working of such a power as this may introduce into one's ideas of personality and responsibility is perilous–madness lies that way. But truth is truth, and I am almost fain to believe in this magical visibility of the non-existent when the only alternative is the supposition that the writer of the article on "Materialism and Morality" in vol. xl. (1886) of the "Fortnightly Review," in spite of his manifest ability and honesty, has pledged himself, so far as I am concerned, to what, if I may trust my own knowledge of my own thoughts, must be called a multitude of errors of the first magnitude.

I so much admire Mr. Lilly's outspokenness, I am so completely satisfied with the uprightness of his intentions, that it is repugnant to me to quarrel with anything he may say; and I sympathise so warmly with his manly scorn of the vileness of much that passes under the name of literature in these times, that I would willingly be silent under his by no means unkindly exposition of his theory of my own tenets, if I thought that such personal abnegation would serve the interest of the cause we both have at heart. But I cannot think so. My creed may be an ill-favoured thing, but it is mine own, as Touchstone says of his lady-love; and I have so high an opinion of the solid virtues of the object of my affections that I cannot calmly see her personated by a wench who is much [119] uglier and has no virtue worth speaking of. I hope I should be ready to stand by a falling cause if I had ever adopted it; but suffering for a falling cause, which one has done one's best to bring to the ground, is a kind of martyrdom for which I have no taste. In my opinion, the philosophical theory which Mr. Lilly attributes to me–but which I have over and over again disclaimed–is untenable and destined to extinction; and I not unreasonably demur to being counted among its defenders.

After the manner of a mediæval disputant, Mr. Lilly posts up three theses, which, as he conceives, embody the chief heresies propagated by the late Professor Clifford, Mr. Herbert Spencer, and myself. He says that we agree "(1) in putting aside, as unverifiable, everything which the senses cannot verify; (2) everything beyond the bounds of physical science; (3) everything which cannot be brought into a laboratory and dealt with chemically" (p. 578).

My lamented young friend Clifford, sweetest of natures though keenest of disputants, is out of reach of

our little controversies, but his works speak for him, and those who run may read a refutation of Mr. Lilly's assertions in them. Mr. Herbert Spencer, hitherto, has shown no lack either of ability or of inclination to speak for himself; and it would be a superfluity, not to say an impertinence, on my part, to take up the cudgels for him. But, for myself, if my know[120]ledge of my own consciousness may be assumed to be adequate (and I make not the least pretension to acquaintance with what goes on in my "Unbewusstsein"), I may be permitted to observe that the first proposition appears to me to be not true; that the second is in the same case; and that, if there be gradations in untrueness, the third is so monstrously untrue that it hovers on the verge of absurdity, even if it does not actually flounder in that logical limbo. Thus, to all three theses, I reply in appropriate fashion, *Nego*–I say No; and I proceed to state the grounds of that negation, which the proprieties do not permit me to make quite so emphatic as I could desire.

Let me begin with the first assertion, that I "put aside, as unverifiable, everything which the senses cannot verify." Can such a statement as this be seriously made in respect of any human being? But I am not appointed apologist for mankind in general; and confining my observations to myself, I beg leave to point out that, at this present moment, I entertain an unshakable conviction that Mr. Lilly is the victim of a patent and enormous misunderstanding, and that I have not the slightest intention of putting that conviction aside because I cannot "verify" it either by touch, or taste, or smell, or hearing, or sight, which (in the absence of any trace of telepathic faculty) make up the totality of my senses.

Again, I may venture to admire the clear and [121] vigorous English in which Mr. Lilly embodies his views; but the source of that admiration does not lie in anything which my five senses enable me to discover in the pages of his article, and of which an orang-outang might be just as acutely sensible. No, it lies in an appreciation of literary form and logical structure by æsthetic and intellectual faculties which are not senses, and which are not unfrequently sadly wanting where the senses are in full vigour. My poor relation may beat me in the matter of sensation; but I am quite confident that, when style and syllogisms are to be dealt with, he is nowhere.

If there is anything in the world which I do firmly believe in, it is the universal validity of the law of causation; but that universality cannot be proved by any amount of experience, let alone that which comes to us through the senses. And when an effort of volition changes the current of my thoughts, or when an idea calls up another associated idea, I have not the slightest doubt that the process to which the first of the phenomena, in each case, is due stands in the relation of cause to the second. Yet the attempt to verify this belief by sensation would be sheer lunacy. Now I am quite sure that Mr. Lilly does not doubt my sanity; and the only alternative seems to be the admission that his first proposition is erroneous.

The second thesis charges me with putting [122] aside "as unverifiable" "everything beyond the bounds of physical science." Again I say, No. Nobody, I imagine, will credit me with a desire to limit the empire of physical science, but I really feel bound to confess that a great many very familiar and, at the same time, extremely important phenomena lie quite beyond its legitimate limits. I cannot conceive, for example, how the phenomena of consciousness, as such and apart from the physical process by which they are called into existence, are to be brought within the bounds of physical science. Take the simplest possible example, the feeling of redness. Physical science tells us that it commonly arises as a

consequence of molecular changes propagated from the eye to a certain part of the substance of the brain, when vibrations of the luminiferous ether of a certain character fall upon the retina. Let us suppose the process of physical analysis pushed so far that one could view the last link of this chain of molecules, watch their movements as if they were billiard balls, weigh them, measure them, and know all that is physically knowable about them. Well, even in that case, we should be just as far from being able to include the resulting phenomenon of consciousness, the feeling of redness, within the bounds of physical science, as we are at present. It would remain as unlike the phenomena we know under the names of matter and motion as it is now. If there is any [123] plain truth upon which I have made it my business to insist over and over again it is this–and whether it is a truth or not, my insistence upon it leaves not a shadow of justification for Mr. Lilly's assertion.

But I ask in this case also, how is it conceivable that any man, in possession of all his natural faculties, should hold such an opinion? I do not suppose that I am exceptionally endowed because I have all my life enjoyed a keen perception of the beauty offered us by nature and by art. Now physical science may and probably will, some day, enable our posterity to set forth the exact physical concomitants and conditions of the strange rapture of beauty. But if ever that day arrives, the rapture will remain, just as it is now, outside and beyond the physical world; and, even in the mental world, something superadded to mere sensation. I do not wish to crow unduly over my humble cousin the orang, but in the æsthetic province, as in that of the intellect, I am afraid he is nowhere. I doubt not he would detect a fruit amidst a wilderness of leaves where I could see nothing; but I am tolerably confident that he has never been awestruck, as I have been, by the dim religious gloom, as of a temple devoted to the earth-gods, of the tropical forests which he inhabits. Yet I doubt not that our poor long-armed and short-legged friend, as he sits meditatively munching his durian fruit, has something [124] behind that sad Socratic face of his which is utterly "beyond the bounds of physical science." Physical science may know all about his clutching the fruit and munching it and digesting it, and how the physical titillation of his palate is transmitted to some microscopic cells of the gray matter of his brain. But the feelings of sweetness and of satisfaction which, for a moment, hang out their signal lights in his melancholy eyes, are as utterly outside the bounds of physics as is the "fine frenzy" of a human rhapsodist.

Does Mr. Lilly really believe that, putting me aside, there is any man with the feeling of music in him who disbelieves in the reality of the delight which he derives from it, because that delight lies outside the bounds of physical science, not less than outside the region of the mere sense of hearing? But, it may be, that he includes music, painting, and sculpture under the head of physical science, and in that case I can only regret I am unable to follow him in his ennoblement of my favourite pursuits.

The third thesis runs that I put aside "as unverifiable" "everything which cannot be brought into a laboratory and dealt with chemically"; and, once more, I say No. This wondrous allegation is no novelty; it has not unfrequently reached me from that region where gentle (or ungentle) dulness so often holds unchecked sway–the pulpit. But I marvel to find that a [125] writer of Mr. Lilly's intelligence and good faith is willing to father such a wastrel. If I am to deal with the thing seriously, I find myself met by one of the two horns of a dilemma. Either some meaning, as unknown to usage as to the dictionaries, attaches to "laboratory" and "chemical," or the proposition is (what am I to say in my sore need for a gentle and yet appropriate word?)–well–unhistorical.

Does Mr. Lilly suppose that I put aside "as unverifiable" all the truths of mathematics, of philology, of history? And if I do not, will he have the great goodness to say how the binomial theorem is to be dealt with "chemically," even in the best-appointed "laboratory"; or where the balances and crucibles are kept by which the various theories of the nature of the Basque language may be tested; or what reagents will extract the truth from any given History of Rome, and leave the errors behind as a residual calx?

I really cannot answer these questions, and unless Mr. Lilly can, I think he would do well hereafter to think more than twice before attributing such preposterous notions to his fellow-men, who, after all, as a learned counsel said, are vertebrated animals.

The whole thing perplexes me much; and I am sure there must be an explanation which will leave Mr. Lilly's reputation for common sense [126] and fair dealing untouched. Can it be–I put this forward quite tentatively–that Mr. Lilly is the victim of a confusion, common enough among thoughtless people, and into which he has fallen unawares? Obviously, it is one thing to say that the logical methods of physical science are of universal applicability, and quite another to affirm that all subjects of thought lie within the province of physical science. I have often declared my conviction that there is only one method by which intellectual truth can be reached, whether the subject-matter of investigation belongs to the world of physics or to the world of consciousness; and one of the arguments in favour of the use of physical science as an instrument of education which I have oftenest used is that, in my opinion, it exercises young minds in the appreciation of inductive evidence better than any other study. But while I repeat my conviction that the physical sciences probably furnish the best and most easily appreciable illustrations of the one and indivisible mode of ascertaining truth by the use of reason, I beg leave to add that I have never thought of suggesting that other branches of knowledge may not afford the same discipline; and assuredly I have never given the slightest ground for the attribution to me of the ridiculous contention that there is nothing true outside the bounds of physical science. Doubtless people who wanted to say something damaging, without too nice a regard to its truth or falsehood, have often enough misrepresented my plain meaning. But Mr. Lilly is not one of these folks at whom one looks and passes by, and I can but sorrowfully wonder at finding him in such company.

So much for the three theses which Mr. Lilly has nailed on to the page of this Review. I think I have shown that the first is inaccurate, that the second is inaccurate, and that the third is inaccurate; and that these three inaccurates constitute one prodigious, though I doubt not unintentional, misrepresentation. If Mr. Lilly and I were dialectic gladiators, fighting in the arena of the "Fortnightly," under the eye of an editorial lanista, for the delectation of the public, my best tactics would now be to leave the field of battle. For the question whether I do, or do not, hold certain opinions is a matter of fact, with regard to which my evidence is likely to be regarded as conclusive–at least until such time as the telepathy of the unconscious is more generally recognised.

However, some other assertions are made by Mr. Lilly which more or less involve matters of opinion whereof the rights and wrongs are less easily settled, but in respect of which he seems to me to err quite as seriously as about the topics we have been hitherto discussing. And the importance of these subjects

leads me to venture upon saying something about them, even though I am [128] thereby compelled to leave the safe ground of personal knowledge.

Before launching the three torpedoes which have so sadly exploded on board his own ship, Mr. Lilly says that with whatever "rhetorical ornaments I may gild my teaching," it is "Materialism." Let me observe, in passing, that rhetorical ornament is not in my way, and that gilding refined gold would, to my mind, be less objectionable than varnishing the fair face of truth with that pestilent cosmetic, rhetoric. If I believed that I had any claim to the title of "Materialist," as that term is understood in the language of philosophy and not in that of abuse, I should not attempt to hide it by any sort of gilding. I have not found reason to care much for hard names in the course of the last thirty years, and I am too old to develop a new sensitiveness. But, to repeat what I have more than once taken pains to say in the most unadorned of plain language, I repudiate, as philosophical error, the doctrine of Materialism as I understand it, just as I repudiate the doctrine of Spiritualism as Mr. Lilly presents it, and my reason for thus doing is, in both cases, the same; namely, that, whatever their differences, Materialists and Spiritualists agree in making very positive assertions about matters of which I am certain I know nothing, and about which I believe they are, in truth, just as ignorant. And further, that, even when their [129] assertions are confined to topics which lie within the range of my faculties, they often appear to me to be in the wrong. And there is yet another reason for objecting to be identified with either of these sects; and that is that each is extremely fond of attributing to the other, by way of reproach, conclusions which are the property of neither, though they infallibly flow from the logical development of the first principles of both. Surely a prudent man is not to be reproached because he keeps clear of the squabbles of these philosophical Bianchi and Neri, by refusing to have anything to do with either?

I understand the main tenet of Materialism to be that there is nothing in the universe but matter and force; and that all the phenomena of nature are explicable by deduction from the properties assignable to these two primitive factors. That great champion of Materialism whom Mr. Lilly appears to consider to be an authority in physical science, Dr. Büchner, embodies this article of faith on his title-page. *Kraft und Stoff*–force and matter–are paraded as the Alpha and Omega of existence. This I apprehend is the fundamental article of the faith materialistic; and whosoever does not hold it is condemned by the more zealous of the persuasion (as I have some reason to know) to the Inferno appointed for fools or hypocrites. But all this I heartily disbelieve; and at the risk of being charged with [130] wearisome repetition of an old story, I will briefly give my reasons for persisting in my infidelity. In the first place, as I have already hinted, it seems to me pretty plain that there is a third thing in the universe, to wit, consciousness, which, in the hardness of my heart or head, I cannot see to be matter, or force, or any conceivable modification of either, however intimately the manifestations of the phenomena of consciousness may be connected with the phenomena known as matter and force. In the second place, the arguments used by Descartes and Berkeley to show that our certain knowledge does not extend beyond our states of consciousness, appear to me to be as irrefragable now as they did when I first became acquainted with them some half-century ago. All the materialistic writers I know of who have tried to bite that file have simply broken their teeth. But, if this is true, our one certainty is the existence of the mental world, and that of *Kraft und Stoff* falls into the rank of, at best, a highly probable hypothesis.

Thirdly, when I was a mere boy, with a perverse tendency to think when I ought to have been playing, my mind was greatly exercised by this formidable problem, What would become of things if they lost their qualities? As the qualities had no objective existence, and the thing without qualities was nothing, the solid world seemed whittled away–to my great horror. As I grew [131] older, and learned to use the terms matter and force, the boyish problem was revived, *mutato nomine*. On the one hand, the notion of matter without force seemed to resolve the world into a set of geometrical ghosts, too dead even to jabber. On the other hand, Boscovich's hypothesis, by which matter was resolved into centres of force, was very attractive. But when one tried to think it out, what in the world became of force considered as an objective entity? Force, even the most materialistic of philosophers will agree with the most idealistic, is nothing but a name for the cause of motion. And if, with Boscovich, I resolved things into centres of force, then matter vanished altogether and left immaterial entities in its place. One might as well frankly accept Idealism and have done with it.

I must make a confession, even if it be humiliating. I have never been able to form the slightest conception of those "forces" which the Materialists talk about, as if they had samples of them many years in bottle. They tell me that matter consists of atoms, which are separated by mere space devoid of contents; and that, through this void, radiate the attractive and repulsive forces whereby the atoms affect one another. If anybody can clearly conceive the nature of these things which not only exist in nothingness, but pull and push there with great vigour, I envy him for the possession of an intellect of larger grasp, not only than mine, but than that of [132] Leibnitz or of Newton.[1] To me the "chimæra, bombinans in vacuo quia comedit secundas intentiones" of the schoolmen is a familiar and domestic creature compared with such "forces." Besides, by the hypothesis, the forces are not matter; and thus all that is of any particular consequence in the world turns out to be not matter on the Materialist's own showing. Let it not be supposed that I am casting a doubt upon the propriety of the employment of the terms "atom" and "force," as they stand among the working hypotheses of physical science. As formulæ which can be applied, with perfect precision and great convenience, in the interpretation of nature, their value is incalculable; but, as real entities, having an objective existence, an indivisible particle which nevertheless occupies space is surely inconceivable; and with respect to the operation of that atom, where it is not, by the aid of a "force" resident in nothingness, I am as little able to imagine it as I fancy any one else is.

Unless and until anybody will resolve all these doubts and difficulties for me, I think I have a right to hold aloof from Materialism. As to Spiritualism, it lands me in even greater difficul[133]ties when I want to get change for its notes-of-hand in the solid coin of reality. For the assumed substantial entity, spirit, which is supposed to underlie the phenomena of Consciousness, as matter underlies those of physical nature, leaves not even a geometrical ghost when these phenomena are abstracted. And, even if we suppose the existence of such an entity apart from qualities–that is to say, a bare existence–for mind, how does anybody know that it differs from that other entity, apart from qualities, which is the supposed substratum of matter? Spiritualism is, after all, little better than Materialism turned upside down. And if I try to think of the "spirit" which a man, by this hypothesis, carries about under his hat, as something devoid of relation to space, and as something indivisible, even in thought, while it is, at the same time, supposed to be in that place and to be possessed of half a dozen different faculties, I confess I get quite lost.

As I have said elsewhere, if I were forced to choose between Materialism and Idealism, I should elect for the latter; and I certainly would have nothing to do with the effete mythology of Spiritualism. But I am not aware that I am under any compulsion to choose either the one or the other. I have always entertained a strong suspicion that the sage who maintained that man is the measure of the universe was sadly in the wrong; and age and experience have not weakened [134] that conviction. In following these lines of speculation I am reminded of the quarter-deck walks of my youth. In taking that form of exercise you may perambulate through all points of the compass with perfect safety, so long as you keep within certain limits: forget those limits, in your ardour, and mere smothering and spluttering, if not worse, await you. I stick by the deck and throw a lifebuoy now and then to the struggling folk who have gone overboard; and all I get for my humanity is the abuse of all whenever they leave off abusing one another.

Tolerably early in life I discovered that one of the unpardonable sins, in the eyes of most people, is for a man to presume to go about unlabelled. The world regards such a person as the police do an unmuzzled dog, not under proper control. I could find no label that would suit me, so, in my desire to range myself and be respectable, I invented one; and, as the chief thing I was sure of was that I did not know a great many things that the–ists and the–ites about me professed to be familiar with, I called myself an Agnostic. Surely no denomination could be more modest or more appropriate; and I cannot imagine why I should be every now and then haled out of my refuge and declared sometimes to be a Materialist, sometimes an Atheist, sometimes a Positivist; and sometimes, alas and alack, a cowardly or reactionary Obscurantist.

[136] I trust that I have, at last, made my case clear, and that henceforth I shall be allowed to rest in peace–at least, after a further explanation or two, which Mr. Lilly proves to me may be necessary. It has been seen that my excellent critic has original ideas respecting the meaning of the words "laboratory" and "chemical"; and, as it appears to me, his definition of "Materialist" is quite as much peculiar to himself. For, unless I misunderstand him, and I have taken pains not to do so, he puts me down as a Materialist (over and above the grounds which I have shown to have no foundation); firstly, because I have said that consciousness is a function of the brain; and, secondly, because I hold by determinism. With respect to the first point, I am not aware that there is any one who doubts that, in the proper physiological sense of the word function, consciousness, in certain forms at any rate, is a cerebral function. In physiology we call function that effect, or series of effects, which results from the activity of an organ. Thus, it is the function of muscle to give rise to motion; and the muscle gives rise to motion when the nerve which supplies it is stimulated. If one of the nerve-bundles in a man's arm is laid bare and a stimulus is applied to certain of the nervous filaments, the result will be production of motion in that arm. If others are stimulated, the result will be the production of the state of consciousness called pain. Now, if I trace these last nerve-filaments, I find them to be ultimately connected with part of the substance of the brain, just as the others turn out to be connected with muscular substance. If the production of motion in the one case is properly said to be the function of the muscular substance, why is the production of a state of consciousness in the other case not to be called a function of the cerebral substance? Once upon a time, it is true, it was supposed that a certain "animal spirit" resided in muscle and was the real active agent. But we have done with that wholly superfluous fiction so far as the

muscular organs are concerned. Why are we to retain a corresponding fiction for the nervous organs?

If it is replied that no physiologist, however spiritual his leanings, dreams of supposing that simple sensations require a "spirit" for their production, then I must point out that we are all agreed that consciousness is a function of matter, and that particular tenet must be given up as a mark of Materialism. Any further argument will turn upon the question, not whether consciousness is a function of the brain, but whether all forms of consciousness are so. Again, I hold it would be quite correct to say that material changes are the causes of psychical phenomena (and, as a consequence, that the organs in which these changes take place have [137] the production of such phenomena for their function), even if the spiritualistic hypothesis had any foundation. For nobody hesitates to say that an event A is the cause of an event Z, even if there are as many intermediate terms, known and unknown, in the chain of causation as there are letters between A and Z. The man who pulls the trigger of a loaded pistol placed close to another's head certainly is the cause of that other's death, though, in strictness, he "causes" nothing but the movement of the finger upon the trigger. And, in like manner, the molecular change which is brought about in a certain portion of the cerebral substance by the stimulation of a remote part of the body would be properly said to be the cause of the consequent feeling, whatever unknown terms were interposed between the physical agent and the actual psychical product. Therefore, unless Materialism has the monopoly of the right use of language, I see nothing materialistic in the phraseology which I have employed.

The only remaining justification which Mr. Lilly offers for dubbing me a Materialist, *malgré moi,* arises out of a passage which he quotes, in which I say that the progress of science means the extension of the province of what we call matter and force, and the concomitant gradual banishment from all regions of human thought of what we call spirit and spontaneity. I hold that opinion now, [138] if anything, more firmly than I did when I gave utterance to it a score of years ago, for it has been justified by subsequent events. But what that opinion has to do with Materialism I fail to discover. In my judgment, it is consistent with the most thorough-going Idealism, and the grounds of that judgment are really very plain and simple.

The growth of science, not merely of physical science, but of all science, means the demonstration of order and natural causation among phenomena which had not previously been brought under those conceptions. Nobody who is acquainted with the progress of scientific thinking in every department of human knowledge, in the course of the last two centuries, will be disposed to deny that immense provinces have been added to the realm of science; or to doubt that the next two centuries will be witnesses of a vastly greater annexation. More particularly in the region of the physiology of the nervous system is it justifiable to conclude from the progress that has been made in analysing the relations between material and psychical phenomena, that vast further advances will be made; and that, sooner or later, all the so-called spontaneous operations of the mind will have, not only their relations to one another, but their relations to physical phenomena, connected in natural series of causes and effects, strictly defined. In other words, while, at present, we know only the nearer [139] moiety of the chain of causes and effects, by which the phenomena we call material give rise to those which we call mental; hereafter, we shall get to the further end of the series.

In my innocence, I have been in the habit of supposing that this is merely a statement of facts, and that the good Bishop Berkeley, if he were alive, would find such facts fit into his system without the least difficulty. That Mr. Lilly should play into the hands of his foes, by declaring that unmistakable facts make for them, is an exemplification of ways that are dark, quite unintelligible to me. Surely Mr. Lilly does not hold that the disbelief in spontaneity–which term, if it has any meaning at all, means uncaused action–is a mark of the beast Materialism? If so, he must be prepared to tackle many of the Cartesians (if not Descartes himself), Spinoza and Leibnitz among the philosophers, Augustine, Thomas Aquinas, Calvin and his followers among theologians, as Materialists–and that surely is a sufficient *reductio ad absurdum* of such a classification.

The truth is, that in his zeal to paint "Materialism," in large letters, on everything he dislikes, Mr. LiIly forgets a very important fact, which, however, must be patent to every one who has paid attention to the history of human thought; and that fact is, that every one of the speculative difficulties which beset Kant's three problems, the existence of a Deity, the freedom of the [140] will, and immortality, existed ages before anything that can be called physical science, and would continue to exist if modern physical science were swept away. All that physical science has done has been to make, as it were, visible and tangible some difficulties that formerly were more hard of apprehension. Moreover, these difficulties exist just as much on the hypothesis of Idealism as on that of Materialism.

The student of nature, who starts from the axiom of the universality of the law of causation, cannot refuse to admit an eternal existence; if he admits the conservation of energy, he cannot deny the possibility of an eternal energy; if he admits the existence of immaterial phenomena in the form of consciousness, he must admit the possibility, at any rate, of an eternal series of such phenomena; and, if his studies have not been barren of the best fruit of the investigation of nature, he will have enough sense to see that when Spinoza says, "Per Deum intelligo ens absolute infinitum, hoc est substantiam constantem infinitis attributis," the God so conceived is one that only a very great fool would deny, even in his heart. Physical science is as little Atheistic as it is Materialistic.

So with respect to immortality. As physical science states this problem, it seems to stand thus: "Is there any means of knowing whether the series of states of consciousness, which has been [141] casually associated for threescore years and ten with the arrangement and movements of innumerable millions of successively different material molecules, can be continued, in like association, with some substance which has not the properties of matter and force?" As Kant said, on a like occasion, if anybody can answer that question, he is just the man I want to see. If he says that consciousness cannot exist, except in relation of cause and effect with certain organic molecules, I must ask how he knows that; and if he says it can, I must put the same question. And I am afraid that, like jesting Pilate, I shall not think it worth while (having but little time before me) to wait for an answer.

Lastly, with respect to the old riddle of the freedom of the will. In the only sense in which the word freedom is intelligible to me–that is to say, the absence of any restraint upon doing what one likes within certain limits–physical science certainly gives no more ground for doubting it than the common sense of mankind does. And if physical science, in strengthening our belief in the universality of causation and

abolishing chance as an absurdity, leads to the conclusions of determinism, it does no more than follow the track of consistent and logical thinkers in philosophy and in theology, before it existed or was thought of. Whoever accepts the universality of the law of causation as a dogma of philosophy, denies the [142] existence of uncaused phenomena. And the essence of that which is improperly called the freewill doctrine is that occasionally, at any rate, human volition is self-caused, that is to say, not caused at all; for to cause oneself one must have anteceded oneself–which is, to say the least of it, difficult to imagine.

Whoever accepts the existence of an omniscient Deity as a dogma of theology, affirms that the order of things is fixed from eternity to eternity; for the fore-knowledge of an occurrence means that the occurrence will certainly happen; and the certainty of an event happening is what is meant by its being fixed or fated.[2] Whoever asserts the existence of an omnipotent Deity, that he made and sustains all things, and is the *causa causarum,* cannot, without a contradiction in terms, assert that there is any cause independent of him; and it is a mere subterfuge to assert that the cause of all things can "permit" one of these things to be an independent cause.

[143] Whoever asserts the combination of omniscience and omnipotence as attributes of the Deity, does implicitly assert predestination. For he who knowingly makes a thing and places it in circumstances the operation of which on that thing he is perfectly acquainted with, does predestine that thing to whatever fate may befall it.

Thus, to come, at last, to the really important part of all this discussion, if the belief in a God is essential to morality, physical science offers no obstacle thereto; if the belief in immortality is essential to morality, physical science has no more to say against the probability of that doctrine than the most ordinary experience has, and it effectually closes the mouths of those who pretend to refute it by objections deduced from merely physical [144] data. Finally, if the belief in the uncausedness of volition is essential to morality, the student of physical science has no more to say against that absurdity than the logical philosopher or theologian. Physical science, I repeat, did not invent determinism, and the deterministic doctrine would stand on just as firm a foundation as it does if there were no physical science. Let any one who doubts this read Jonathan Edwards, whose demonstrations are derived wholly from philosophy and theology.

Thus, when Mr. Lilly, like another Solomon Eagle, goes about proclaiming "Woe to this wicked city," and denouncing physical science as the evil genius of modern days–mother of materialism, and fatalism, and all sorts of other condemnable isms–I venture to beg him to lay the blame on the right shoulders; or, at least, to put in the dock, along with Science, those sinful sisters of hers, Philosophy and Theology, who, being so much older, should have known better than the poor Cinderella of the schools and universities over which they have so long dominated. No doubt modern society is diseased enough; but then it does not differ from older civilisations in that respect. Societies of men are fermenting masses, and, as beer has what the Germans call "Oberhefe" and "Unterhefe," so every society that has existed has had its scum at the top and its dregs at the bottom; but I doubt if any of the [145] "ages of faith" had less scum or less dregs, or even showed a proportionally greater quantity of sound wholesome stuff in

the vat. I think it would puzzle Mr. Lilly, or any one else, to adduce convincing evidence that, at any period of the world's history, there was a more widespread sense of social duty, or a greater sense of justice, or of the obligation of mutual help, than in this England of ours. Ah! but, says Mr. Lilly, these are all products of our Christian inheritance; when Christian dogmas vanish virtue will disappear too, and the ancestral ape and tiger will have full play. But there are a good many people who think it obvious that Christianity also inherited a good deal from Paganism and from Judaism; and that, if the Stoics and the Jews revoked their bequest, the moral property of Christianity would realise very little. And, if morality has survived the stripping off of several sets of clothes which have been found to fit badly, why should it not be able to get on very well in the light and handy garments which Science is ready to provide?

But this by the way. If the diseases of society consist in the weakness of its faith in the existence of the God of the theologians, in a future state, and in uncaused volitions, the indication, as the doctors say, is to suppress Theology and Philosophy, whose bickerings about things of which they know nothing have been the prime cause and continual sustenance of that evil scepticism [146] which is the Nemesis of meddling with the unknowable.

Cinderella is modestly conscious of her ignorance of these high matters. She lights the fire, sweeps the house, and provides the dinner; and is rewarded by being told that she is a base creature, devoted to low and material interests. But in her garret she has fairy visions out of the ken of the pair of shrews who are quarrelling down stairs. She sees the order which pervades the seeming disorder of the world; the great drama of evolution, with its full share of pity and terror, but also with abundant goodness and beauty, unrolls itself before her eyes; and she learns, in her heart of hearts, the lesson, that the foundation of morality is to have done, once and for all, with lying; to give up pretending to believe that for which there is no evidence, and repeating unintelligible propositions about things beyond the possibilities of knowledge.

She knows that the safety of morality lies neither in the adoption of this or that philosophical speculation, or this or that theological creed, but in a real and living belief in that fixed order of nature which sends social disorganisation upon the track of immorality, as surely as it sends physical disease after physical trespasses. And of that firm and lively faith it is her high mission to be the priestess.

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[1] See the famous *Collection of Papers*, published by Clarke in 1717. Leibnitz says: "'Tis also a supernatural thing that bodies should *attract* one another at a distance without any intermediate means." And Clarke, on behalf of Newton, caps this as follows: "That one body should attract another without any intermediate *means* is, indeed, not a *miracle*, but a contradiction; for 'tis supposing something to act where it is not."

[2] I may cite, in support of this obvious conclusion of sound reasoning, two authorities who will certainly not be regardcd lightly by Mr. Lilly. These are Augustine and Thomas Aquinas. The former declares that "Fate" is only an ill-chosen name for Providence.

"Prorsus divina providentia regna constituuntur humana. Quæ si propterea quisquam fato tribuit, quia ipsam Dei voluntatem vel potestatem fati nomine appellat, *sententiam teneat, linguam corrigat*" (Augustinus *De Civitate Dei,* V. c. i.)

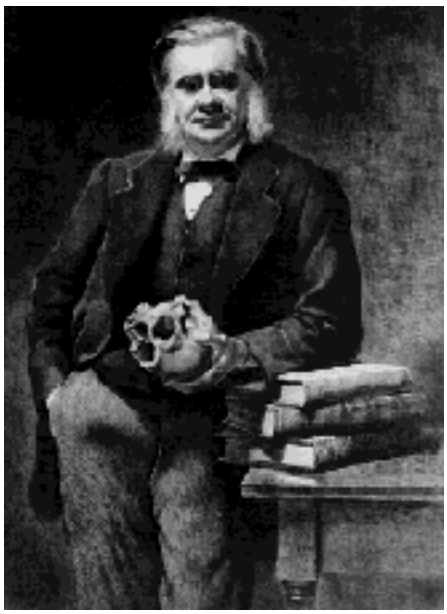
The other great doctor of the Catholic Church, "Divus Thomas," as Suarez calls him, whose marvellous grasp and subtlety of intellect seem to me to be almost without a parallel, puts the whole case into a nutshell, when he says that the ground for doing a thing in the mind of the doer is as it were the pre-existence of the thing done:

"Ratio autem alicujus fiendi in mente actoris existens est quædam præ-existentia rei fiendæ in eo" *(Summa,* Qu. xxiii. Art. xi.)

If this is not enugh, I may further ask what "Materialist" has ever given a better statement of the case for determinism, on theistic grounds, than is to be found in the following passage of the Summa, Qu. xiv. Art. xiii.

"Omnia quæ sunt in tempore, sunt Deo ab æterno præsentia, non solum ea ex ratione quâ habet rationes rerum apud se presentes, ut quidam dicunt, sed quia ejus intuitus fertur ab æterno supra omnia, prout sunt in sua præsentialitate. *Unde manifestum est quod contingentia infallibiliter a Deo cognoscuntur,* in quantum subduntur divino conspectui secundum suam præsentialitatem; et tamen sunt futura contingentia, suis causis proximis comparata."

[As I have not said that Thomas Aquinas is professedly a determinist, I do not see the bearing of citations from him which may be more or less inconsistent with the foregoing.]



Capital–The Mother of Labour

An Economical Problem Discussed from a Physiological Point of View (March 1890)

Collected Essays IX

[147] THE first act of a new-born child is to draw a deep breath. In fact, it will never draw a deeper, inasmuch as the passages and chambers of the lungs, once distended with air, do not empty themselves again; it is only a fraction of their contents which passes in and out with the flow and the ebb of the respiratory tide. Mechanically, this act of drawing breath, or inspiration, is of the same nature as that by which the handles of a bellows are separated, in order to fill the bellows with air; and, in like manner, it involves that expenditure of energy which we call exertion, or work, or labour. It is, therefore, no mere metaphor to say that man is destined to a life of toil: the work of respiration which began with his first breath ends only with his last; nor does one born [148] in the purple get off with a lighter task than the child who first sees light under a hedge.

How is it that the new-born infant is enabled to perform this first instalment of the sentence of life-long labour which no man may escape? Whatever else a child may be, in respect of this particular question, it is a complicated piece of mechanism, built up out of materials supplied by its mother; and in the course of such building-up, provided with a set of motors–the muscles. Each of these muscles contains a stock of substance capable of yielding energy under certain conditions, one of which is a change of state in the nerve fibres connected with it. The powder in a loaded gun is such another stock of substance capable of yielding energy in consequence of a change of state in the mechanism of the lock, which intervenes between the finger of the man who pulls the trigger and the cartridge. If that change is brought about, the potential energy of the powder passes suddenly into actual energy, and does the work of propelling the bullet. The powder, therefore, may be appropriately called *work-stuff*, not only because it is stuff which is easily made to yield work in the physical sense, but because a good deal of work in the economical sense has contributed to its production. Labour was necessary to collect, transport, and purify the raw sulphur and saltpetre; to cut wood and convert it into powdered charcoal; to mix these in[149]gredients in the right proportions; to give the mixture the proper grain, and so on. The powder once formed part of the stock, or capital, of a powder-maker: and it is not only certain natural bodies which are collected and stored in the gunpowder, but the labour bestowed on the operations mentioned may be figuratively said to be incorporated in it.

In principle, the work-stuff stored in the muscles of the new-born child is comparable to that stored in the gun-barrel. The infant is launched into altogether new surroundings; and these operate through the mechanism of the nervous machinery, with the result that the potential energy of some of the work-stuff in the muscles which bring about inspiration is suddenly converted into actual energy; and this, operating through the mechanism of the respiratory apparatus, gives rise to an act of inspiration. As the bullet is propelled by the "going off" of the powder, as it might be said that the ribs are raised and the midriff depressed by the "going off" of certain portions of muscular work-stuff. This work-stuff is part

of a stock or capital of that commodity stored up in the child's organism before birth, at the expense of the mother; and the mother has made good her expenditure by drawing upon the capital of food-stuffs which furnished her daily maintenance.

Under these circumstances, it does not appear [150] to me to be open to doubt that the primary act of outward labour in the series which necessarily accompany the life of man is dependent upon the pre-existence of a stock of material which is not only of use to him, but which is disposed in such a manner as to be utilisable with facility. And I further imagine that the propriety of the application of the term 'capital' to this stock of useful substance cannot be justly called in question; inasmuch as it is easy to prove that the essential constituents of the work-stuff accumulated in the child's muscles have merely been transferred from the store of food-stuffs, which everybody admits to be capital, by means of the maternal organism to that of the child, in which they are again deposited to await use. Every subsequent act of labour, in like manner, involves an equivalent consumption of the child's store of work-stuff–its vital capital; and one of the main objects of the process of breathing is to get rid of some of the effects of that consumption. It follows, then, that, even if no other than the respiratory work were going on in the organism, the capital of work-stuff, which the child brought with it into the world, must sooner or later be used up, and the movements of breathing must come to an end; just as the see-saw of the piston of a steam-engine stops when the coal in the fireplace has burnt away.

Milk, however, is a stock of materials which [151] essentially consists of savings from the food-stuffs supplied to the mother. And these savings are in such a physical and chemical condition that the organism of the child can easily convert them into work-stuff. That is to say, by borrowing directly from the vital capital of the mother, indirectly from the store in the natural bodies accessible to her, it can make good the loss of its own. The operation of borrowing, however, involves further work; that is, the labour of sucking, which is a mechanical operation of much the same nature as breathing. The child thus pays for the capital it borrows in labour; but as the value in work-stuff of the milk obtained is very far greater than the value of that labour, estimated by the consumption of work-stuff it involves, the operation yields a large profit to the infant. The overplus of food-stuff suffices to increase the child's capital of work-stuff; and to supply not only the materials for the enlargement of the "buildings and machinery" which is expressed by the child's growth, but also the energy required to put all these materials together, and to carry them to their proper places. Thus, throughout the years of infancy, and so long thereafter as the youth or man is not thrown upon his own resources, he lives by consuming the vital capital provided by others. To use a terminology which is more common than appropriate, whatever work he performs (and he does [152] a good deal, if only in mere locomotion) is unproductive.

Let us now suppose the child come to man's estate in the condition of a wandering savage, dependent for his food upon what he can pick up or catch, after the fashion of the Australian aborigines. It is plain that the place of mother, as the supplier of vital capital, is now taken by the fruits, seeds, and roots of plants and by various kinds of animals. It is they alone which contain stocks of those substances which can be converted within the man's organism into work-stuff; and of the other matters, except air and water, required to supply the constant consumption of his capital and to keep his organic machinery going. In no way does the savage contribute to the production of these substances. Whatever labour he bestows upon such vegetable and animal bodies, on the contrary, is devoted to their destruction; and it is a mere

matter of accident whether a little labour yields him a great deal–as in the case, for example, of a stranded whale; or whether much labour yields next to nothing–as in times of long-continued drought. The savage, like the child, borrows the capital he needs, and, at any rate, intentionally, does nothing towards repayment; it would plainly be an improper use of the word "produce" to say that his labour in hunting for the roots, or the fruits, or the eggs, or the grubs and snakes, which he finds and eats, "pro [153]duces" or contributes to "produce" them. The same thing is true of more advanced tribes, who are still merely hunters, such as the Esquimaux. They may expend more labour and skill; but it is spent in destruction.

When we pass from these to men who lead a purely pastoral life, like the South American Gauchos, or some Asiatic nomads, there is an important change. Let us suppose the owner of a flock of sheep to live on the milk, cheese, and flesh which they yield. It is obvious that the flock stands to him in the economic relation of the mother to the child, inasmuch as it supplies him with food-stuffs competent to make good the daily and hourly losses of his capital of workstuff. If we imagine our sheep-owner to have access to extensive pastures and to be troubled neither by predacious animals nor by rival shepherds, the performance of his pastoral functions will hardly involve the expenditure of any more labour than is needful to provide him with the exercise required to maintain health. And this is true, even if we take into account the trouble originally devoted to the domestication of the sheep. It surely would be a most singular pretension for the shepherd to talk of the flock as the "produce" of his labour in any but a very limited sense. In truth, his labour would have been a mere accessory of production of very little consequence. Under the circumstances supposed, [154] a ram and some ewes, left to themselves for a few years, would probably generate as large a flock; and the superadded labour of the shepherd would have little more effect upon their production than upon that of the blackberries on the bushes about the pastures. For the most part the increment would be thoroughly unearned; and, if it is a rule of absolute political ethics that owners have no claim upon "betterment" brought about independently of their own labour, then the shepherd would have no claim to at least nine-tenths of the increase of the flock.

But if the shepherd has no real claim to the title of "producer," who has? Are the rams and ewes the true "producers"? Certainly their title is better if, borrowing from the old terminology of chemistry, they only claim to be regarded as the "proximate principles" of production. And yet, if strict justice is to be dispensed, even they are to be regarded rather as collectors and distributors than as "producers." For all that they really do is to collect, slightly modify, and render easily accessible, the vital capital which already exists in the green herbs on which they feed, but in such a form as to be practically out of the reach of man.

Thus, from an economic point of view, the sheep are more comparable to confectioners than to producers. The usefulness of biscuit lies in the raw flour of which it is made; but raw flour [156] does not answer as an article of human diet, and biscuit does. So the usefulness of mutton lies mainly in certain chemical compounds which it contains: the sheep gets them out of grass; we cannot live on grass, but we can on mutton.

Now, herbaceous and all other green plants stand alone among terrestrial natural bodies, in so far as, under the influence of light, they possess the power to build up, out of the carbonic acid gas in the

atmosphere, water and certain nitrogenous and mineral salts, those substances which in the animal organism are utilised as work-stuff. They are the chief and, for practical purposes, the sole producers of that vital capital which we have seen to be the necessary antecedent of every act of labour. Every green plant is a laboratory in which, so long as the sun shines upon it, materials furnished by the mineral world, gases, water, saline compounds, are worked up into those foodstuffs without which animal life cannot be carried on. And since, up to the present time, synthetic chemistry has not advanced so far as to achieve this feat, the green plant may be said to be the only living worker whose labour directly results in the production of that vital capital which is the necessary antecedent of human labour.[1] Nor is this statement a paradox involving perpetual [156] motion, because the energy by which the plant does its work is supplied by the sun–the primordial capitalist so far as we are concerned. But it cannot be too strongly impressed upon the mind that sunshine, air, water, the best soil that is to be found on the surface of the earth, might co-exist; yet without plants, there is no known agency competent to generate the so-called "protein compounds," by which alone animal life can be permanently supported. And not only are plants thus essential; but, in respect of particular kinds of animals, they must be plants of a particular nature. If there were no terrestrial green plants but, say, cypresses and mosses, pastoral and agricultural life would be alike impossible; indeed, it is difficult to imagine the possibility of the existence of any large animal, as the labour required to get at a sufficiency of the store of food-stuffs, contained in such plants as these, could hardly extract from them an equivalent for the waste involved in that expenditure of work.

We are compact of dust and air; from that we set out, and to that complexion must we come at last. The plant either directly, or by some animal intermediary, lends us the capital which enables us to carry on the business of life, as we flit through the upper world, from the one term of our journey to the other. Popularly, no doubt, it is permissible to speak of the soil as a "pro[157]ducer," just as we may talk of the daily movement of the sun. But, as I have elsewhere remarked, propositions which are to bear any deductive strain that may be put upon them must run the risk of seeming pedantic, rather than that of being inaccurate. And the statement that land, in the sense of cultivable soil, is a producer, or even one of the essentials of economic production, is anything but accurate. The process of water-culture, in which a plant is not "planted" in any soil, but is merely supported in water containing in solution the mineral ingredients essential to that plant, is now thoroughly understood; and, if it were worth while, a crop yielding abundant food-stuffs could be raised on an acre of fresh water, no less than on an acre of dry land. In the Arctic regions, again, land has nothing to do with "production" in the social economy of the Esquimaux, who live on seals and other marine animals; and might, like Proteus, shepherd the flocks of Poseidon if they had a mind for pastoral life. But the seals and the bears are dependent on other inhabitants of the sea, until, somewhere in the series, we come to the minute green plants which float in the ocean, and are the real "producers" by which the whole of its vast animal population is supported.[2]

[158] Thus, when we find set forth as an "absolute" truth the statement that the essential factors in economic production are land, capital and labour–when this is offered as an axiom whence all sorts of other important truths may be deduced–it is needful to remember that the assertion is true only with a qualification. Undoubtedly "vital capital" is essential; for, as we have seen, no human work can be done unless it exists, not even that internal work of the body which is necessary to passive life. But, with

respect to labour (that is, human labour) I hope to have left no doubt on the reader's mind that, in regard to production, the importance of human labour may be so small as to be almost a vanishing quantity. Moreover, it is certain that there is no approximation to a fixed ratio between the expenditure of labour and the production of that vital capital which is the foundation of all wealth. For, suppose that we introduce into our suppositious pastoral paradise beasts of prey and rival shepherds, the amount of labour thrown upon the sheep-owner may increase almost indefinitely, and its importance as a condition of production may be enormously augmented, while the quantity of produce remains stationary. Compare for a moment the unim[159]portance of the shepherd's labour, under the circumstances first defined, with its indispensability in countries in which the water for the sheep has to be drawn from deep wells, or in which the flock has to be defended from wolves or from human depredators. As to land, it has been shown that, except as affording mere room and standing ground, the importance of land, great as it may be, is secondary. The one thing needful for economic production is the green plant, as the sole producer of vital capital from natural inorganic bodies. Men might exist without labour (in the ordinary sense) and without land; without plants they must inevitably perish.

That which is true of the purely pastoral condition is *a fortiori* true of the purely agricultural[3] condition, in which the existence of the cultivator is directly dependent on the production of vital capital by the plants which he cultivates. Here, again, the condition precedent of the work of each year is vital capital. Suppose that a man lives exclusively upon the plants which he cultivates. It is obvious that he must have food-stuffs to live upon, while he prepares the soil for sowing and throughout the period which elapses between this and harvest. These food-stuffs must be yielded by the stock remaining over from former crops. [160] The result is the same as before–the pre-existence of vital capital is the necessary antecedent of labour. Moreover, the amount of labour which contributes, as an accessory condition, to the production of the crop varies as widely in the case of plant-raising as in that of cattle-raising. With favourable soil, climate and other conditions, it may be very small, with unfavourable, very great, for the same revenue or yield of food-stuffs.

Thus, I do not think it is possible to dispute the following proposition: the existence of any man, or of any number of men, whether organised into a polity or not, depends on the production of foodstuffs (that is, vital capital) readily accessible to man, either directly or indirectly, by plants. But it follows that the number of men who can exist, say for one year, on any given area of land, taken by itself, depends upon the quantity of food-stuffs produced by such plants growing on the area in one year. If a is that quantity, and b the minimum of food-stuffs required for each man, $a/b = n$, the maximum number of men who can exist on the area. Now the amount of production (a) is limited by the extent of area occupied; by the quantity of sunshine which falls upon the area; by the range and distribution of temperature; by the force of the winds; by the supply of water; by the composition and the physical characters of the soil; by animal and vegetable competitors and des[161]troyers. The labour of man neither does, nor can, produce vital capital; all that it can do is to modify, favourably or unfavourably, the conditions of its production. The most important of these–namely, sunshine, range of daily and nightly temperature, wind–are practically out of men's reach.[4] On the other hand, the supply of water, the physical and chemical qualities of the soil, and the influences of competitors and destroyers, can often, though by no means always, be largely affected by labour and skill. And there is no harm in calling the effect of such labour

"production," if it is clearly understood that "production" in this sense is a very different thing from the "production" of food-stuffs by a plant.

We have been dealing hitherto with suppositions the materials of which are furnished by everyday experience, not with mere *a priori* assumptions. Our hypothetical solitary shepherd with his flock, or the solitary farmer with his grain field, are mere bits of such experience, cut out, as it were, for easy study. Still borrowing from daily experience, let us suppose that either sheep-owner or farmer, for any reason that may be imagined, [162] desires the help of one or more other men; and that, in exchange for their labour, he offers so many sheep, or quarts of milk, or pounds of cheese, or so many measures of grain, for a year's service. I fail to discover any *a priori* "rights of labour" in virtue of which these men may insist on being employed, if they are not wanted. But, on the other hand, I think it is clear that there is only one condition upon which the persons to whom the offer of these "wages" is made can accept it; and that is that the things offered in exchange for a year's work shall contain at least as much vital capital as a man uses up in doing the year's work. For no rational man could knowingly and willingly accept conditions which necessarily involve starvation. Therefore there is an irreducible minimum of wages; it is such an amount of vital capital as suffices to replace the inevitable consumption of the person hired. Now, surely, it is beyond a doubt that these wages, whether at or above the irreducible minimum, are paid out of the capital disposable after the wants of the owner of the flock or of the crop of grain are satisfied; and, from what has been said already, it follows that there is a limit to the number of men, whether hired, or brought in in any other way, who can be maintained by the sheepowner or landowner out of his own resources. Since no amount of labour can produce an ounce of foodstuff beyond the maximum producible by a limited [163] number of plants, under the most favourable circumstances in regard to those conditions which are not affected by labour, it follows that, if the number of men to be fed increases indefinitely, a time must come when some will have to starve. That is the essence of the so-called Malthusian doctrine; and it is a truth which, to my mind, is as plain as the general proposition that a quantity which constantly increases will, some time or other, exceed any greater quantity the amount of which is fixed.

The foregoing considerations leave no doubt about the fundamental condition of the existence of any polity, or organised society of men, either in a purely pastoral or purely agricultural state, or in any mixture of both states. It must possess a store of vital capital to start with, and the means of repairing the consumption of that capital which takes place as a consequence of the work of the members of the society. And, if the polity occupies a completely isolated area of the earth's surface, the numerical strength of that polity can never exceed the quotient of the maximum quantity of food-stuffs producible by the green plants on that area, in each year, divided by the quantity necessary for the maintenance of each person during the year. But, there is a third mode of existence possible to a polity; it may, conceivably, be neither purely pastoral nor purely agricultural, but purely manufacturing. Let us [164] suppose three islands, like Gran Canaria, Teneriffe and Lanzerote, in the Canaries, to be quite cut off from the rest of the world. Let Gran Canaria be inhabited by grain-raisers, Teneriffe by cattle-breeders; while the population of Lanzerote (which we may suppose to be utterly barren) consists of carpenters, woollen manufacturers, and shoemakers. Then the facts of daily experience teach us that the people of Lanzerote could never have existed unless they came to the island provided with a stock of food-stuffs; and that they could not continue to exist, unless that stock, as it was consumed, was made up by

contributions from the vital capital of either Gran Canaria, or Teneriffe, or both. Moreover, the carpenters of Lanzerote could do nothing, unless they were provided with wood from the other islands; nor could the wool spinners and weavers or the shoemakers work without wool and skins from the same sources. The wood and the wool and the skins are, in fact, the capital without which their work as manufacturers in their respective trades is impossible–so that the vital and other capital supplied by Gran Canaria and Teneriffe is most indubitably the necessary antecedent of the industrial labour of Lanzerote. It is perfectly true that by the time the wood, the wool, and the skins reached Lanzerote a good deal of labour in cutting, shearing, skinning, transport, and so on, would have been spent upon them. But this [165] does not alter the fact that the only "production" which is essential to the existence of the population of Teneriffe and Gran Canaria is that effected by the green plants in both islands; and that all the labour spent upon the raw produce useful in manufacture, directly or indirectly yielded by them–by the inhabitants of these islands and by those of Lanzerote into the bargain–will not provide one solitary Lanzerotian with a dinner, unless the Teneriffians and Canariotes happen to want his goods and to be willing to give some of their vital capital in exchange for them.

Under the circumstances defined, if Teneriffe and Gran Canaria disappeared, or if their inhabitants ceased to care for carpentry, clothing, or shoes, the people of Lanzerote must starve. But if they wish to buy, then the Lanzerotians, by "cultivating" the buyers, indirectly favour the cultivation of the produce of those buyers.

Thus, if the question is asked whether the labour employed in manufacture in Lanzerote is "productive" or "unproductive" there can be only one reply. If anybody will exchange vital capital, or that which can be exchanged for vital capital, for Lanzerote goods, it is productive; if not, it is unproductive.

In the case of the manufacturer, the dependence of labour upon capital is still more intimate than in that of the herdsman or agriculturist. When the latter are once started they can go on, without [166] troubling themselves about the existence of any other people. But the manufacturer depends on pre-existing capital, not only at the beginning, but at the end of his operations. However great the expenditure of his labour and of his skill, the result, for the purpose of maintaining his existence, is just the same as if he had done nothing, unless there is a customer able and willing to exchange food-stuffs for that which his labour and skill have achieved.

There is another point concerning which it is very necessary to have clear ideas. Suppose a carpenter in Lanzerote to be engaged in making chests of drawers. Let us suppose that *a*, the timber, and *b*, the grain and meat needful for the man's sustenance until he can finish a chest of drawers, have to be paid for by that chest. Then the capital with which he starts is represented by $a + b$. He could not start at all unless he had it; day by day, he must destroy more or less of the substance and of the general adaptability of *a* in order to work it up into the special forms needed to constitute the chest of drawers; and, day by day, he must use up at least so much of *b* as will replace his loss of vital capital by the work of that day. Suppose it takes the carpenter and his workmen ten days to saw up the timber, to plane the boards, and to give them the shape and size proper for the various parts of the chest of drawers. And suppose that he then [167] offers his heap of boards to the advancer of $a + b$ as an equivalent for the wood + ten days' supply of vital capital? The latter will surely say: "No. I did not ask for a heap of boards. I asked for a

chest of drawers. Up to this time, so far as I am concerned, you have done nothing and are as much in my debt as ever." And if the carpenter maintained that he had "virtually" created two-thirds of a chest of drawers, inasmuch as it would take only five days more to put together the pieces of wood, and that the heap of boards ought to be accepted as the equivalent of two-thirds of his debt, I am afraid the creditor would regard him as little better than an impudent swindler. It obviously makes no sort of difference whether the Canariote or Teneriffian buyer advanced the wood and the food-stuffs, on which the carpenter had to maintain himself; or whether the carpenter had a stock of both, the consumption of which must be recouped by the exchange of a chest of drawers for a fresh supply. In the latter case, it is even less doubtful that, if the carpenter offered his boards to the man who wanted a chest of drawers, the latter would laugh in his face. And if he took the chest of drawers for himself, then so much of his vital capital would be sunk in it past recovery. Again, the payment of goods in a lump, for the chest of drawers, comes to the same thing as the payment of daily wages for the fifteen days that [168] the carpenter was occupied in making it. If, at the end of each day, the carpenter chose to say to himself "I have 'virtually' created, by my day's labour, a fifteenth of what I shall get for the chest of drawers–therefore my wages are the produce of my day's labour"–there is no great harm in such metaphorical speech, so long as the poor man does not delude himself into the supposition that it represents the exact truth. "Virtually" is apt to cover more intellectual sins than "charity" does moral delicts. After what has been said, it surely must be plain enough that each day's work has involved the consumption of the carpenter's vital capital, and the fashioning of his timber, at the expense of more or less consumption of those forms of capital. Whether the $a + b$ to be exchanged for the chest has been advanced as a *loan,* or is paid daily or weekly as *wages*, or, at some later time, as the *price* of a finished commodity–the essential element of the transaction, and the only essential element, is, that it must, at least, effect the replacement of the vital capital consumed. Neither boards nor chest of drawers are eatable; and, so far from the carpenter having produced the essential part of his wages by each day's labour, he has merely wasted that labour, unless somebody who happens to want a chest of drawers offers to exchange vital capital, or something that can procure it, equivalent to the [169] amount consumed during the process of manufacture.[5]

That it should be necessary, at this time of day, to set forth such elementary truths as these may well seem strange; but no one who consults that interesting museum of political delusions, "Progress and Poverty," some of the treasures of which I have already brought to light, will doubt the fact, if he bestows proper attention upon the first book of that widely-read work. At page 15 it is thus written:

"The proposition I shall endeavour to prove is: that wages, instead of being drawn from capital, are, in reality, drawn from the product of the labour for which they are paid."

Again at page 18:–

"In every case in which labour is exchanged for commodities, production really precedes enjoyment . . . wages are the earnings–that is to say, the makings–of labour–not the advances of capital."

And the proposition which the author endeavours to disprove is the hitherto generally accepted doctrine

"that labour is maintained and paid out of existing capital, before the product which constitutes the ultimate object is secured" (p. 16).

The doctrine respecting the relation of capital and wages, which is thus opposed in "Progress and [170] Poverty," is that illustrated in the foregoing pages; the truth of which, I conceive, must be plain to any one who has apprehended the very simple arguments by which I have endeavoured to demonstrate it. One conclusion or the other must be hopelessly wrong; and, even at the cost of going once more over some of the ground traversed in this essay and that on "Natural and Political Rights,"[6] I propose to show that the error lies with "Progress and Poverty"; in which work, so far as political science is concerned, the poverty is, to my eye, much more apparent than the progress.

To begin at the beginning. The author propounds a definition of wealth: "Nothing which nature supplies to man without his labour is wealth" (p. 28). Wealth consists of "natural substances or products which have been adapted by human labour to human use or gratification, their value depending upon the amount of labour which, upon the average, would be required to produce things of like kind" (p. 27). The following examples of wealth are given:–

"Buildings, cattle, tools, machinery, agricultural and mineral products, manufactured goods, ships, waggons, furniture, and the like" (p. 27).

I take it that native metals, coal and brick clay, are "mineral products"; and I quite believe that they are properly termed "wealth." But when a seam of coal crops out at the surface, and [171] lumps of coal are to be had for the picking up; or when native copper lies about in nuggets, or when brick clay forms a superficial stratum, it appears to me that these things are supplied to, nay almost thrust upon, man without his labour. According to the definition, therefore, they are not "wealth." According to the enumeration, however, they are "wealth": a tolerably fair specimen of a contradiction in terms. Or does "Progress and Poverty" really suggest that a coal seam which crops out at the surface is not wealth; but that if somebody breaks off a piece and carries it away, the bestowal of this amount of labour upon that particular lump makes it wealth; while the rest remains "not wealth"? The notion that the value of a thing bears any necessary relation to the amount of labour (average or otherwise) bestowed upon it, is a fallacy which needs no further refutation than it has already received. The average amount of labour bestowed upon warming-pans confers no value upon them in the eyes of a Gold-Coast negro; nor would an Esquimaux give a slice of blubber for the most elaborate of ice-machines.

So much for the doctrine of "Progress and Poverty" touching the nature of wealth. Let us now consider its teachings respecting capital as wealth or a part of wealth. Adam Smith's definition "that part of a man's stock which he expects to yield him a revenue is called his capital" is quoted with approval (p. 32); else[172]where capital is said to be that part of wealth "which is devoted to the aid of production" (p. 28); and yet again it is said to be

"*wealth in course of exchange*,[7] understanding exchange to include, not merely the passing from hand to hand, but also such transmutations as occur when the reproductive or transforming forces of nature are utilised for the

increase of wealth" (p. 32).

But if too much pondering over the possible senses and scope of these definitions should weary the reader, he will be relieved by the following acknowledgment:–

"Nor is the definition of capital I have suggested of any importance" (p. 33).

The author informs us, in fact, that he is "not writing a text-book," thereby intimating his opinion that it is less important to be clear and accurate when you are trying to bring about a political revolution than when a merely academic interest attaches to the subject treated. But he is not busy about anything so serious as a textbook: no, he "is only attempting to discover the laws which control a great social problem"–a mode of expression which indicates perhaps the high-water mark of intellectual muddlement. I have heard, in my time, of "laws" which control other "laws"; but this is the first occasion on which "laws" which "control a problem" have come under my notice. Even the disquisitions "of [173] those flabby writers who have burdened the press and darkened counsel by numerous volumes which are dubbed political economy" (p. 28) could hardly furnish their critics with a finer specimen of that which a hero of the "Dunciad," by the one flash of genius recorded of him, called "clotted nonsense."

Doubtless it is a sign of grace that the author of these definitions should attach no importance to any of them; but since, unfortunately, his whole argument turns upon the tacit assumption that they are important, I may not pass them over so lightly. The third I give up. Why anything should be capital when it is "in course of exchange," and not be capital under other circumstances, passes my understanding. We are told that "that part of a farmer's crop held for sale or for seed, or to feed his help, in part payment of wages, would be accounted capital; that held for the care of his family would not be" (p. 31). But I fail to discover any ground of reason or authority for the doctrine that it is only when a crop is about to be sold or sown, or given as wages, that it may be called capital. On the contrary, whether we consider custom or reason, so much of it as is stored away in ricks and barns during harvest, and remains there to be used in any of these ways months or years afterwards, is customarily and rightly termed capital. Surely, the meaning of the clumsy phrase that capital is "wealth in the course of exchange" must be that it is "wealth capable of [174] being exchanged" against labour or anything else. That, in fact, is the equivalent of the second definition, that capital is "that part of wealth which is devoted to the aid of production." Obviously, if you possess that for which men will give labour, you can aid production by means of that labour. And, again, it agrees with the first definition (borrowed from Adam Smith) that capital is "that part of a man's stock which he expects to yield him a revenue." For a revenue is both etymologically and in sense a "return." A man gives his labour in sowing grain, or in tending cattle, because he expects a "return"–a "revenue"–in the shape of the increase of the grain or of the herd; and also, in the latter case, in the shape of their labour and manure which "aid the production" of such increase. The grain and cattle of which he is possessed immediately after harvest is his capital; and his revenue for the twelvemonth, until the next harvest, is the surplus of grain and cattle over and above the amount with which he started. This is disposable for any purpose for which he may desire to use it, leaving him just as well off as he was at the beginning of the year. Whether the man keeps the surplus grain for sowing more land, and the surplus cattle for occupying more pasture; whether he exchanges them for other commodities, such as the use of the land (as rent); or labour (as wages); or

whether he feeds himself and his [175] family, in no way alters their nature as revenue, or affects the fact that this revenue is merely disposable capital.

That (even apart from etymology) cattle are typical examples of capital cannot be denied ("Progress and Poverty," p. 25); and if we seek for that particular quality of cattle which makes them "capital," neither has the author of "Progress and Poverty" supplied, nor is any one else very likely to supply, a better account of the matter than Adam Smith has done. Cattle are "capital" because they are "stock which yields revenue." That is to say, they afford to their owner a supply of that which he desires to possess. And, in this particular case, the "revenue" is not only desirable, but of supreme importance, inasmuch as it is capable of maintaining human life. The herd yields a revenue of food-stuffs as milk and meat; a revenue of skins; a revenue of manure; a revenue of labour; a revenue of exchangeable commodities in the shape of these things, as well as in that of live cattle. In each and all of these capacities cattle are capital; and, conversely, things which possess any or all of these capacities are capital.

Therefore what we find at page 25 of "Progress and Poverty" must be regarded as a welcome lapse into clearness of apprehension:–

"A fertile field, a rich vein of ore, a falling stream which supplies power, may give the possessor advantages equivalent to the [176] possession of capital; but to class such things as capital would be to put an end to the distinction between land and capital."

Just so. But the fatal truth is that these things are capital; and that there really is no fundamental distinction between land and capital. Is it denied that a fertile field, a rich vein of ore, or a falling stream, may form part of a man's stock, and that, if they do, they are capable of yielding revenue? Will not somebody pay a share of the produce in kind, or in money, for the privilege of cultivating the first royalties for that of working the second; and a like equivalent for that of erecting a mill on the third? In what sense, then, are these things less "capital" than the buildings and tools which on page 27 of "Progress and Poverty" are admitted to be capital? Is it not plain that if these things confer "advantages equivalent to the possession of capital," and if the "advantage" of capital is nothing but the yielding of revenue, then the denial that they are capital is merely a roundabout way of self-contradiction?

All this confused talk about capital, however, is lucidity itself compared with the exposition of the remarkable thesis, "Wages not drawn from capital, but produced by labour," which occupies the third chapter of "Progress and Poverty."

"If, for instance, I devote my labour to gathering birds' eggs or picking wild berries, the eggs or berries I thus get are my wages. Surely no one will contend that, in such a case, wages are drawn from capital. There is no capital in the case" (p. 34).

[177] Nevertheless, those who have followed what has been said in the first part of this essay surely neither will, nor can, have any hesitation about substantially adopting the challenged contention, though they may possibly have qualms as to the propriety of the use of the term "wages."[8] They will have no

difficulty in apprehending the fact that birds' eggs and berries are stores of foodstuffs, or vital capital; that the man who devotes his labour to getting them does so at the expense of his personal vital capital; and that, if the eggs and the berries are "wages" for his work, they are so because they enable him to restore to his organism the vital capital which he has consumed in doing the work of collection. So that there is really a great deal of "capital in the case."

Our author proceeds:–

"An absolutely naked man, thrown on an island where no human being has before trod, may gather birds' eggs or pick berries" (p. 34).

No doubt. But those who have followed my argument thus far will be aware that a man's vital capital does not reside in his clothes; and, therefore, they will probably fail, as completely as I do, to discover the relevancy of the statement.

[178] Again:–

"Or, if I take a piece of leather and work it up into a pair of shoes, the shoes are my wages–the reward of my exertion. Surely they are not drawn from capital–either my capital or anybody else's capital–but are brought into existence by the labour of which they became the wages; and, in obtaining this pair of shoes as the wages of my labour, capital is not even momentarily lessened one iota. For if we call in the idea of capital, my capital at the beginning consists of the piece of leather, the thread, &c." (p. 34).

It takes away one's breath to have such a concatenation of fallacies administered in the space of half a paragraph. It does not seem to have occurred to our economical reformer to imagine whence his "capital at the beginning," the "leather, thread, &c." came. I venture to suppose that leather to have been originally cattle-skin; and since calves and oxen are not flayed alive, the existence of the leather implies the lessening of that form of capital by a very considerable iota. It is, therefore, as sure as anything can be that, in the long run, the shoes are drawn from that which is capital *par excellence;* to wit, cattle. It is further beyond doubt that the operation of tanning must involve loss of capital in the shape of bark, to say nothing of other losses; and that the use of the awls and knives of the shoemaker involves loss of capital in the shape of the store of iron; further, the shoemaker has been enabled to do his work not only by the vital capital expended during the time occupied in making the pair of [179] shoes, but by that expended from the time of his birth, up to the time that he earned wages that would keep him alive.

"Progress and Poverty" continues:–

"As my labour goes on, value is steadily added until, when my labour results in the finished shoes, I have my capital plus the difference in value between the material and the shoes. In obtaining this additional value–my wages–how is capital, at any time, drawn upon?" (p, 34).

In return we may inquire, how can any one propound such a question? Capital is drawn upon all the time. Not only when the shoes are commenced, but while they are being made, and until they are either

used by the shoemaker himself or are purchased by somebody else; that is, exchanged for a portion of another man's capital. In fact (supposing that the shoemaker does not want shoes himself), it is the existence of vital capital in the possession of another person and the willingness of that person to part with more or less of it in exchange for the shoes–it is these two conditions, alone, which prevent the shoemaker from having consumed his capital unproductively, just as much as if he had spent his time in chopping up the leather into minute fragments.

Thus, the examination of the very case selected by the advocate of the doctrine that labour bestowed upon manufacture, without any intervention of capital, can produce wages, proves to be a [180] delusion of the first magnitude; even though it be supported by the dictum of Adam Smith which is quoted in its favour (p. 34)–

"The produce of labour constitutes the natural recompense or wages of labour. In that original state of things which precedes both the appropriation of land and the accumulation of stock, the whole produce of labour belongs to the labourer. He has neither landlord nor master to share with him" ("*Wealth of Nations*," ch. viii).

But the whole of this passage exhibits the influence of the French Physiocrats by whom Adam Smith was inspired, at their worst; that is to say, when they most completely forsook the ground of experience for *a priori* speculation. The confident reference to "that original state of things" is quite in the manner of the *Essai sur l'Inégalité*. Now, the state of men before the "appropriation of land" and the "accumulation of stock" must surely have been that of purely savage hunters. As, by the supposition, nobody would have possessed land, certainly no man could have had a landlord; and, if there was no accumulation of stock in a transferable form, as surely there could be no master, in the sense of hirer. But hirer and hire (that is, wages) are correlative terms, like mother and child. As "child" implies "mother," so does "hire" or "wages" imply a "hirer" or "wage-giver." Therefore, when a man in "the original state of things" gathered fruit or killed game for his own sustenance, the fruit or [181] the game could be called his "wages" only in a figurative sense; as one sees if the term "hire," which has a more limited connotation, is substituted for "wage." If not, it must be assumed that the savage hired himself to get his own dinner; whereby we are led to the tolerably absurd conclusion that, as in the "state of nature" he was his own employer, the "master" and the labourer, in that model age, appropriated the produce in equal shares! And if this should be not enough, it has already been seen that, in the hunting state, man is not even an accessory of production of vital capital; he merely consumes what nature produces.

According to the author of "Progress and Poverty" political economists have been deluded by a "fallacy which has entangled some of the most acute minds in a web of their own spinning."

"It is in the use of the term capital in two senses. In the primary proposition that capital is necessary to the exertion of productive labour, the term "capital" is understood as including all food, clothing, shelter, &c.; whereas in the deductions finally drawn from it, the term is used in its common and legitimate meaning of wealth devoted, not to the immediate gratification of desire, but to the procurement of more wealth–of wealth in the hands of employers as distinguished from labourers" (p. 40).

I am by no means concerned to defend the political economists who are thus charged with blundering;

but I shall be surprised to learn that any have carried the art of self-entanglement to [182] the degree of perfection exhibited by this passage. Who has ever imagined that wealth which, in the hands of an employer, is capital, ceases to be capital if it is in the hands of a labourer? Suppose a workman to be paid thirty shillings on Saturday evening for six days' labour, that thirty shillings comes out of the employer's capital, and receives the name of "wages" simply because it is exchanged for labour. In the workman's pocket, as he goes home, it is a part of his capital, in exactly the same sense as, half an hour before, it was part of the employer's capital; he is a capitalist just as much as if he were a Rothschild. Suppose him to be a single man, whose cooking and household matters are attended to by the people of the house in which he has a room; then the rent which he pays them out of this capital is, in part, wages for their labour, and he is, so far, an employer. If he saves one shilling out of his thirty, he has, to that extent, added to his capital when the next Saturday comes round. And if he puts his saved shillings week by week into the Savings Bank, the difference between him and the most bloated of bankers is simply one of degree.

At page 42, we are confidently told that "labourers by receiving wages" cannot lessen "even temporarily" the "capital of the employer," while at page 44 it is admitted that in certain cases the capitalist "pays out capital in wages." One would think that the "paying out" of capital is hardly possible without at least a "temporary" diminution of the capital from which payment is made. But "Progress and Poverty" changes all that by a little verbal legerdemain:–

"For where wages are paid before the object of the labour is obtained, or is finished–as in agriculture, where ploughing and sowing must precede by several months the harvesting of the crop; as in the erection of buildings, the construction of ships, railroads, canals, &c.–it is clear that the owners of the capital paid in wages cannot expect an immediate return, but, as the phrase is, must "outlay it" or "lie out of it" for a time which sometimes amounts to many years. And hence, if first principles are not kept in mind, it is easy to jump to the conclusion that wages are advanced by capital" (p. 44).

Those who have paid attention to the argument of former parts of this paper may not be able to understand how, if sound "first principles are kept in mind," any other conclusion can be reached, whether by jumping, or by any other mode of logical progression. But the first principle which our author "keeps in mind" possesses just that amount of ambiguity which enables him to play hocus-pocus with it. It is this; that "the creation of value does not depend upon the finishing of the product" (p. 44).

There is no doubt that, under certain limitations, this proposition is correct. It is not true that "labour always adds to capital by its exertion before it takes from capital its wages" (p. 44), [184] but it is true that it may, and often does, produce that effect.

To take one of the examples given, the construction of a ship. The shaping of the timbers undoubtedly gives them a value (for a shipbuilder) which they did not possess before. When they are put together to constitute the framework of the ship, there is a still further addition of value (for a shipbuilder); and when the outside planking is added, there is another addition (for a shipbuilder). Suppose everything else about the hull is finished, except the one little item of caulking the seams, there is no doubt that it has still more value for a shipbuilder. But for whom else has it any value, except perhaps for a fire-wood

merchant? What price will any one who wants a ship–that is to say, something that will carry a cargo from one port to another–give for the unfinished vessel which would take water in at every seam and go down in half an hour, if she were launched? Suppose the shipbuilder's capital to fail before the vessel is caulked, and that he cannot find another shipbuilder who cares to buy and finish it, what sort of proportion does the value created by the labour, for which he has paid out of his capital, stand to that of his advances? Surely no one will give him one-tenth of the capital disbursed in wages, perhaps not so much even as the prime cost of the raw materials. Therefore, though the assertion that "the creation [185] of value does not depend on the finishing of the product" may be strictly true under certain circumstances, it need not be and is not always true. And, if it is meant to imply or suggest that the creation of value in a manufactured article does not depend upon the finishing of that article, a more serious error could hardly be propounded.

Is there not a prodigious difference in the value of an uncaulked and in that of a finished ship; between the value of a house in which only the tiles of the roof are wanting and a finished house; between that of a clock which only lacks the escapement and a finished clock?

As ships, house, and clock, the unfinished articles have no value whatever–that is to say, no person who wanted to purchase one of these things, for immediate use, would give a farthing for either. The only value they can have, apart from that of the materials they contain, is that which they possess for some one who can finish them, or for some one who can make use of parts of them for the construction of other things. A man might buy an unfinished house for the sake of the bricks; or he might buy an incomplete clock to use the works for some other piece of machinery.

Thus, though every stage of the labour bestowed on raw material, for the purpose of giving rise to a certain product, confers some additional value on that material in the estimation of those who are [186] engaged in manufacturing that product, the ratio of that accumulated value, at any stage of the process, to the value of the finished product is extremely inconstant, and often small; while, to other persons, the value of the unfinished product may be nothing, or even a *minus* quantity. A house-timber merchant, for example, might consider that wood which had been worked into the ribs of a ship was spoiled–that is, had less value than it had as a log.

According to "Progress and Poverty," there was, really, no advance of capital while the great St. Gothard tunnel was cut. Suppose that, as the Swiss and the Italian halves of the tunnel approached to within half a kilometre, that half-kilometre had turned out to be composed of practically impenetrable rock–would anybody have given a centime for the unfinished tunnel? And if not, how comes it that "the creation of value does not depend on the finishing of the product"?

I think it may be not too much to say that, of all the political delusions which are current in this queer world, the very stupidest are those which assume that labour and capital are necessarily antagonistic; that all capital is produced by labour and therefore, by natural right, is the property of the labourer; that the possessor of capital is a robber who preys on the workman and appropriates to himself that which he has had no share in producing.

[187] On the contrary, capital and labour are, necessarily, close allies; capital is never a product of human labour alone; it exists apart from human labour; it is the necessary antecedent of labour; and it furnishes the materials on which labour is employed. The only indispensable form of capital–vital capital–cannot be produced by human labour. All that man can do is to favour its formation by the real producers. There is no intrinsic relation between the amount of labour bestowed on an article and its value in exchange. The claim of labour to the total result of operations which are rendered possible only by capital is simply an *a priori* iniquity.

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[1] It remains to be seen whether the plants which have no chlorophyll, and flourish in darkness, such as the *Fungi*, can live upon purely mineral food.

[2] In some remarkable passages of the *Botany* of Sir James Ross's Antarctic voyage, which took place half a century ago, Sir Joseph Hooker demonstrated the dependence of the animal life of the sea upon the minute, indeed microscopic, plants which float in it: a marvellous example of what may be done by water-culture. One might indulge in dreams of cultivating and improving diatoms, until the domesticated bore the same relation to the wild forms, as cauliflowers to the primitive *Brassica oleracea*, without passing beyond the limits of fair scientific speculation.

[3] It is a pity that we have no word that signifies plant-culture exclusively. But for the present purpose I may restrict agriculture to that sense.

[4] I do not forget electric lighting, greenhouses and hothouses, and the various modes of affording shelter against violent winds: but in regard to production of food-stuffs on the large scale they may be neglected. Even if synthetic chemistry should effect the construction of proteids, the Laboratory will hardly enter into competition with the Farm within any time which the present generation need trouble itself about.

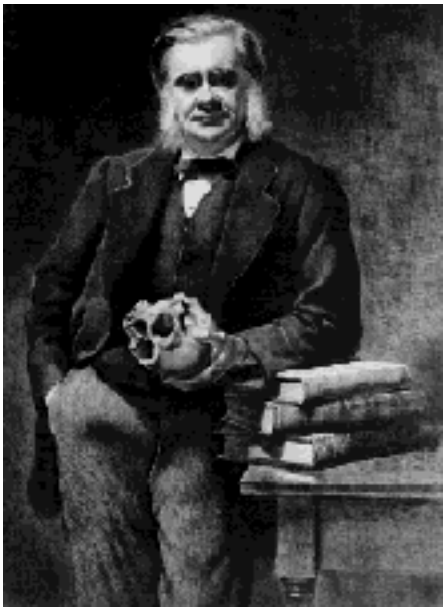
[5] See the discussion of this subject further on.

[6] *Collected Essays*, vol. i. pp. 359-382.

[7] The italics are the author's.

[8] Not merely on the grounds stated below, but on the strength of Mr. George's own definition. Does the gatherer of eggs, or berries, *produce* them by his labour? If so, what do the hens and the bushes do?

THE HUXLEY FILE



Preface and Table of Contents to Volume IX, *Evolution & Ethics and Other Essays*, of Huxley's *Collected Essays.*

Next article: Social Diseases and Worse Remedies [1891], beginning page 188.

Previous article: Science and Morals [1886], pages 117-146.

C. Blinderman & D. Joyce
Clark University

Social Diseases and Worse Remedies (1891)

Letters to the "Times" on Mr. Booth's Scheme with a Preface and Introductory Essay

Collected Essays IX

[1891] Preface

[188] The letters which are here collected together were published in the "Times" in the course of the months of December, 1890, and January, 1891.

The circumstances which led me to write the first letter are sufficiently set forth in its opening sentences; and the materials on which I based my criticisms of Mr. Booth's scheme, in this and in the second letter, were wholly derived from Mr. Booth's book. I had some reason to know, however, that when anybody allows his sense of duty so far to prevail over his sense of the blessedness of peace as to write a letter to the "Times," on [189] any subject of public interest, his reflections, before he has done with the business, will be very like those of Johnny Gilpin, "who little thought, when he set out, of running such a rig." Such undoubtedly are mine when I contemplate these twelve documents, and call to mind the distinct addition to the revenue of the Post Office which must have accrued from the mass of letters and pamphlets which have been delivered at my door; to say nothing of the unexpected light upon my character, motives, and doctrines, which has been thrown by some of the "Times'" correspondents, and by no end of comments elsewhere.

If self-knowledge is the highest aim of man, I ought by this time to have little to learn. And yet, if I am awake, some of my teachers–unable, perhaps, to control the divine fire of the poetic imagination which is so closely akin to, if not a part of, the mythopœic faculty–have surely dreamed dreams. So far as my humbler and essentially prosaic faculties of observation and comparison go, plain facts are against them. But, as I may be mistaken, I have thought it well to prefix to the letters (by way of "Prolegomena") an essay which appeared in the "Nineteenth Century" for January, 1888, in which the principles that, to my mind, lie at the bottom of the "social question" are stated. So far as Individualism and Regimental Socialism are concerned, this paper simply emphasizes and expands [190] the opinions expressed in an address to the members of the Midland Institute, delivered seventeen years earlier, and still more fully developed in several essays published in the "Nineteenth Century" in 1889, which I hope, before long, to republish.[1]

The fundamental proposition which runs through the writings, which thus extend over a period of twenty years, is, that the common *a priori* doctrines and methods of reasoning about political and social questions are essentially vicious; and that argumentation on this basis leads, with equal logical force, to two contradictory and extremely mischievous systems, the one that of Anarchic Individualism, the other that of despotic or Regimental Socialism. Whether I am right or wrong, I am at least consistent in opposing both to the best of my ability. Mr. Booth's system appears to me, and, as I have shown, is

regarded by Socialists themselves, to be mere autocratic Socialism, masked by its theological exterior. That the "fantastic" religious skin will wear away, and the Socialistic reality it covers will show its real nature, is the expressed hope of one candid Socialist, and may be fairly conceived to be the unexpressed belief of the despotic leader of the new Trades Union, who has shown his zeal, if not his discretion, in championing Mr. Booth's projects. [See Letter VIII.]

[191] Yet another word to commentators upon my letters. There are some who rather chuckle, and some who sneer, at what they seem to consider the dexterity of an "old controversial hand," exhibited by the contrast which I have drawn between the methods of conversion depicted in the New Testament and those pursued by fanatics of the Salvationist type, whether they be such as are now exploited by Mr. Booth, or such as those who, from the time of the Anabaptists, to go no further back, have worked upon similar lines.

Whether such observations were intended to be flattering or sarcastic, I must respectfully decline to accept the compliment, or to apply the sarcasm to myself I object to obliquity of procedure and ambiguity of speech in all shapes. And I confess that I find it difficult to understand the state of mind which leads any one to suppose, that deep respect for single-minded devotion to high aims is incompatible with the unhesitating conviction that those aims include the propagation of doctrines which are devoid of foundation–perhaps even mischievous.

The most degrading feature of the narrower forms of Christianity (of which that professed by Mr. Booth is a notable example) is their insistence that the noblest virtues, if displayed by those who reject their pitiable formulæ, are, as their pet phrase goes, "splendid sins." But there is, [192] perhaps, one step lower; and that is that men, who profess freedom of thought, should fail to see and appreciate that large soul of goodness which often animates even the fanatical adherents of such tenets. I am sorry for any man who can read the epistles to the Galatians and the Corinthians without yielding a large meed of admiration to the fervent humanity of Paul of Tarsus; who can study the lives of Francis of Assisi, or of Catherine of Siena, without wishing that, for the furtherance of his own ideals, he might be even as they; or who can contemplate unmoved the steadfast veracity and true heroism which loom through the fogs of mystical utterance in George Fox. In all these great men and women there lay the root of the matter; a burning desire to amend the condition of their fellow-men, and to put aside all other things for that end. If, in spite of all the dogmatic helps or hindrances in which they were entangled, these people are not to be held in high honour, who are?

I have never expressed a doubt–for I have none–that, when Mr. Booth left the Methodist connection, and started that organisation of the Salvation Army upon which, comparatively recently, such ambitious schemes of social reform have been grafted, he may have deserved some share of such honour. I do not say that, so far as his personal desires and intentions go, he may not still deserve it.

[193] But the correlate of despotic authority is unlimited responsibility. If Mr. Booth is to take credit for any good that the Army system has effected, he must be prepared to bear blame for its inherent evils. As it seems to me, that has happened to him which sooner or later happens to all despots: he has become the

slave of his own creation–the prosperity and glory of the soul-saving machine have become the end, instead of a means, of soul-saving; and to maintain these at the proper pitch, the "General" is led to do things which the Mr. Booth of twenty years ago would probably have scorned.

And those who desire, as I most emphatically desire, to be just to Mr. Booth, however badly they may think of the working of the organization he has founded, will bear in mind that some astute backers of his probably care little enough for Salvationist religion; and, perhaps, are not very keen about many of Mr. Booth's projects. I have referred to the rubbing of the hands of the Socialists over Mr. Booth's success;[2] but, unless I err greatly, there are politicians of a certain school to whom it affords still greater satisfaction. Consider what electioneering agents the captains of the Salvation Army, scattered through all our towns, and directed from a political "bureau" in London, would make! Think how political adversaries could be harassed by our local [194] attorney–"tribune of the people," I mean; and how a troublesome man, on the other side, could be "hunted down" upon any convenient charge, whether true or false, brought by our Vigilance-familiar![3]

I entirely acquit Mr. Booth of any complicity in far-reaching schemes of this kind; but I did not write idly when, in my first letter, I gave no vague warning of what might grow out of the organised force, drilled in the habit of unhesitating obedience, which he has created.

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[1] See *Collected Essays*, vol. i. p. 290 to end; and this volume, p. 147.

[2] See *Letter* VIII.

[3] See *Letter* II.

"Who Upset the Booth?"

Huxley Archives

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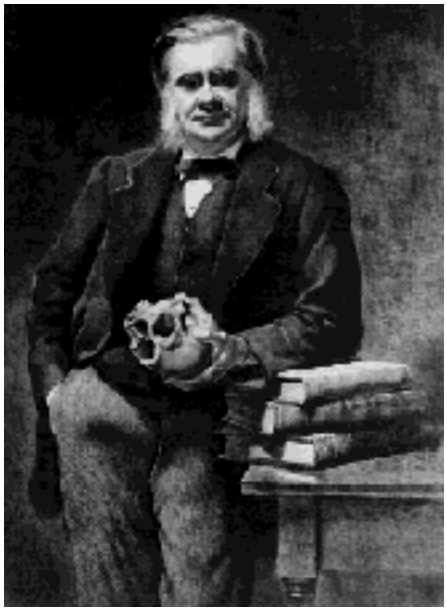

Preface and Table of Contents to Volume IX, *Evolution & Ethics and Other Essays*, of Huxley's *Collected Essays.*

Next part of this article, Social Diseases and Worse Remidies:the introductory essay, The Struggle for Existence in Human Society, pages 195-236.

Previous article: Capital–The Mother of Labour [1890], pages 147-187.

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The Struggle for Existence in Human Society (1888)

Collected Essays IX

[195] The vast and varied procession of events, which we call Nature, affords a sublime spectacle and an inexhaustible wealth of attractive problems to the speculative observer. If we confine our attention to that aspect which engages the attention of the intellect, nature appears a beautiful and harmonious whole, the incarnation of a faultless logical process, from certain premisses in the past to an inevitable conclusion in tile future. But if it be regarded from a less elevated, though more human, point of view; if our moral sympathies are allowed to influence our judgment, and we permit ourselves to criticise our great mother as we criticise one another; then our verdict, at least so far as sentient nature is concerned, can hardly be so favourable.

In sober truth, to those who have made a [196] study of the phenomena of life as they exhibited

by the higher forms of the animal world, the optimistic dogma, that this is the best of all possible worlds, will seem little better than a libel upon possibility. It is really only another instance to be added to the many extant, of the audacity of *a priori* speculators who, having created God in their own image, find no difficulty in assuming that the Almighty must have been actuated by the same motives as themselves. They are quite sure that, had any other course been practicable, He would no more have made infinite suffering a necessary ingredient of His handiwork than a respectable philosopher would have done the like.

But even the modified optimism of the time-honoured thesis of physico-theology, that the sentient world is, on the whole, regulated by principles of benevolence, does but ill stand the test of impartial confrontation with the facts of the case. No doubt it is quite true that sentient nature affords hosts of examples of subtle contrivances directed towards the production of pleasure or the avoidance of pain; and it may be proper to say that these are evidences of benevolence. But if so, why is it not equally proper to say of the equally numerous arrangements, the no less necessary result of which is the production of pain, that . they are evidences of malevolence?

If a vast amount of that which, in a piece of human workmanship, we should call skill, is [197] visible in those parts of the organization of a deer to which it owes its ability to escape from beasts of prey, there is at least equal skill displayed in that bodily mechanism of the wolf which enables him to track, and sooner or later to bring down, the deer. Viewed under the dry light of science, deer and wolf are alike admirable; and, if both were non-sentient automata, there would be nothing to qualify our admiration of the action of the one on the other. But the fact that the deer suffers, while the wolf inflicts suffering, engages our moral sympathies. We should call men like the deer innocent and good, men such as the wolf malignant and bad; we should call those who defended the deer and aided him to escape brave and compassionate, and those who helped the wolf in his bloody work base and cruel. Surely, if we transfer these judgments to nature outside the world of man at all, we must do so impartially. In that case, the

goodness of the right hand which helps the deer, and the wickedness of the left hand which eggs on the wolf, will neutralize one another: and the course of nature will appear to be neither moral nor immoral, but non-moral.

This conclusion is thrust upon us by analogous facts in every part of the sentient world; yet, inasmuch as it not only jars upon prevalent prejudices, but arouses the natural dislike to that which is painful, much ingenuity has been exercised in devising an escape from it.

[198] From the theological side, we are told that this is a state of probation, and that the seeming injustices and immoralities of nature will be compensated by and by. But how this compensation is to be effected, in the case of the great majority of sentient things, is not clear. I apprehend that no one is seriously prepared to maintain that the ghosts of all the myriads of generations of herbivorous animals which lived during the millions of years of the earth's duration, before the appearance of man, and which have all that time been tormented and devoured by carnivores, are to be compensated by a perennial existence in clover; while the ghosts of carnivores are to go to some kennel where there is neither a pan of water nor a bone with any meat on it. Besides, from the point of view of morality, the last stage of things would be worse than the first. For the carnivores, however brutal and sanguinary, have only done that which, if there is any evidence of contrivance in the world, they were expressly constructed to do. Moreover, carnivores and herbivores alike have been subject to all the miseries incidental to old age, disease, and over-multiplication, and both might well put in a claim for "compensation" on this score.

On the evolutionist side, on the other hand, we are told to take comfort from the reflection that

the terrible struggle for existence tends to final good, and that the suffering of the ancestor is paid for by the increased perfection of the progeny. There would be something in this argument if, in [199] Chinese fashion, the present generation could pay its debts to its ancestors; otherwise it is not clear what compensation the *Eohippus* gets for his sorrows in the fact that, some millions of years afterwards, one of his descendants wins the Derby. And, again, it is an error to imagine that evolution signifies a constant tendency to increased perfection. That process undoubtedly involves a constant remodelling of the organism in adaptation to new conditions; but it depends on the nature of those conditions whether the direction of the modifications effected shall be upward or downward. Retrogressive is as practicable as progressive metamorphosis. If what the physical philosophers tell us, that our globe has been in a state of fusion, and, like the sun, is gradually cooling down, is true; then the time must come when evolution will mean adaptation to an universal winter, and all forms of life will die out, except such low and simple organisms as the Diatom of the arctic and antarctic ice and the Protococcus of the red snow. If our globe is proceeding from a condition in which it was too hot to support any but the lowest living thing to a condition in which it will be too cold to permit of the existence of any others, the course of life upon its surface must describe a trajectory like that of a ball fired from a mortar; and the sinking half of that course is as much a part of the general process of evolution as the rising.

From the point of view of the moralist the [200] animal world is on about the same level as a gladiator’s show.. The creatures are fairly well treated, and set to fight–whereby the strongest, the swiftest, and the

cunningest live to fight another day. The spectator has no need to turn his thumbs down, as no quarter is given. He must admit that the skill and training displayed are wonderful. But he must shut his eyes if he would not see that more or less enduring suffering is the meed of both vanquished and victor. And since the great game is going on in every corner of the world, thousands of times a minute; since, were our ears sharp enough, we need not descend to the gates of hell to hear–

sospiri, pianti, ed alti guai.

. . .

Voci alte e floche, e suon di man con elle

–it seems to follow that, if the world is governed by benevolence, it must be a different sort of benevolence from that of John Howard.

But the old Babylonians wisely symbolized Nature by their great goddess Istar, who combined the attributes of Aphrodite with those of Ares. Her terrible aspect is not to be ignored or covered up with shams; but it is not the only one. If the optimism of Leibnitz is a foolish though pleasant dream, the pessimism of Schopenhauer is a nightmare, the more foolish because of its hideousness. Error which is not pleasant is surely the worst form of wrong.

[201] This may not be the best of all possible worlds, but to say that it is the worst is mere petulant nonsense. A worn-out voluptuary may find nothing good under the sun, or a vain and inexperienced youth, who cannot get the moon he cries for, may vent his irritation in pessimistic moanings; but there can be no doubt in the mind of any reasonable person that mankind could, would, and in fact do, get on fairly well with vastly less happiness and far more misery than find their way into the lives of nine people out of ten. If each and all of us had been visited by an attack of neuralgia, or of extreme mental depression, for one hour in every twenty-four–a supposition which many tolerably vigorous people know, to their cost, is not extravagant–the burden of life would have been immensely increased without much practical hindrance to its general course. Men with any manhood in them find life quite worth living under worse conditions than these.

There is another sufficiently obvious fact, which renders the hypothesis that the course of sentient nature is dictated by malevolence quite untenable. A vast multitude of pleasures, and these among the purest and the best, are superfluities, bits of good which are to all appearances unnecessary as inducements to live, and are, so to speak, thrown into the bargain of life. To those who experience them, few delights can be more [202] entrancing than such as are afforded by natural beauty, or by the arts, and especially by music; but they are products of, rather than factors in, evolution, and it is probable that they are known, in any considerable degree, to but a very small proportion of mankind.

The conclusion of the whole matter seems to be that, if Ormuzd has not had his way in this world, neither has Ahriman. Pessimism is as little consonant with the facts of sentient existence as optimism. If

we desire to represent the course of nature in terms of human thought, and assume that it was intended to be that which it is, we must say that its governing principle is intellectual and not moral; that it is a materialized logical process, accompanied by pleasures and pains, the incidence of which, in the majority of cases, has not the slightest reference to moral desert. That the rain falls alike upon the just and the unjust, and that those upon whom the Tower of Siloam fell were no worse than their neighbours, seem to be Oriental modes of expressing the same conclusion.

In the strict sense of the word "nature," it denotes the sum of the phenomenal world, of that

which has been, and is, and will be; and society, like art, is therefore a part of nature. But it is convenient to distinguish those parts of nature in which man plays the part of immediate cause, as [203] some thing apart; and, therefore, society, like art, is usefully to be considered as distinct from nature. It is the more desirable, and even necessary, to make this distinction, since society differs from nature in having a definite moral object; whence it comes about that the course shaped by the ethical man–the member of society or citizen–necessarily runs counter to that which the non-ethical man–the primitive savage, or man as a mere member of the animal kingdom–tends to adopt. The latter fights out the struggle for existence to the bitter end, like any other animal; the former devotes his best energies to the object of setting limits to the struggle. [1]

In the cycle of phenomena presented by the life of man, the animal, no more moral end is discernible than in that presented by the lives of the wolf and of the deer. However imperfect the relics of prehistoric men may be, the evidence which they afford clearly tends to the conclusion that, for thousands and thousands of years, before the origin of the oldest known civilizations, men were savages of a very low type. They strove with their enemies and their competitors; they preyed upon things weaker or less cunning than themselves; they were born, multiplied without stint, and died, for thousands of generations alongside the mammoth, the urus, the lion, and [204] the hyaena, whose lives were spent in the same way; and they were no more to be praised or blamed on moral grounds, than their less erect and more hairy compatriots.

As among these, so among primitive men, the weakest and stupidest went to the wall, while the toughest and shrewdest, those who were best fitted to cope with their circumstances, but not the best in any other sense, survived. Life was a continual free fight, and beyond the limited and temporary relations of the family, the Hobbesian war of each against all was the normal state **of** existence. The human species, like others, plashed and floundered amid the general stream of evolution, keeping its head above water as it best might, and thinking neither of whence nor whither.

The history of civilization–that is, of society–on the other hand, is the record of the attempts which the human race has made to escape from this position. The first men who substituted the state of mutual peace for that of mutual war, whatever the motive which impelled them to take that step, created society. But, in establishing peace, they obviously put a limit upon the struggle for existence. Between the members of that society, at any rate, it was not to be pursued *a outrance.* And of all the successive shapes which society has taken, that most nearly approaches perfection in which the war of individual

against individual is most strictly limited.

[205] The primitive savage, tutored by Istar, appropriated whatever took his fancy, and killed whomsoever opposed him, if he could. On the contrary, the ideal of the ethical man is to limit his freedom of action to a sphere in which he does not interfere with the freedom of others; he seeks the common weal as much as his own; and, indeed, as an essential part of his own welfare. Peace is both end and means with him; and he founds his life on a more or less complete self-restraint, which is the negation of the unlimited struggle for existence. He tries to escape from his place in the animal kingdom, founded on the free development of the principle of non-moral evolution, and to establish a kingdom of Man, governed upon tile principle of moral evolution. For society not only has a moral end, but in its perfection, social life, is embodied morality.

But the effort of ethical man to work towards a moral end by no means abolished, perhaps has hardly modified, the deep-seated organic impulses which impel the natural man to follow his non-moral course. One of the most essential conditions, if not the chief cause, of the struggle for existence, is the tendency to multiply without limit, which man shares with all living things. It is notable that "increase and multiply" is a commandment traditionally much older than the ten; and that it is, perhaps, the only one which [206] has been spontaneously and *ex animo* obeyed by the great majority of the human race. But, in civilized society, the inevitable result of such obedience is the re-establishment, in all its intensity, of that struggle for existence–the war of each against all–the mitigation or abolition of which was the chief end of social organization.

It is conceivable that, at some period in the history of the fabled Atlantis, the production of food should have been exactly sufficient to meet the wants of the population, that the makers of the commodities of the artificer should have amounted to just the number supportable by the surplus food of the agriculturists. And, as there is no harm in adding another monstrous supposition to the foregoing, let it be imagined that every man, woman, and child was perfectly virtuous, and aimed at the good of all as the highest personal good. In that happy land, the natural man would have been finally put down by the ethical man. There would have been no competition, but the industry of each would have been serviceable to all; nobody being vain and nobody avaricious, there would have been no rivalries; the struggle for existence would have been abolished, and the millennium would have finally set in. But it is obvious that this state of things could have been permanent only with a stationary population. Add ten fresh mouths; and as, by the supposition, there was [207] only exactly enough before, somebody must go on short rations. The Atlantis society might have been a heaven upon earth, the whole nation might have consisted of just men, needing no repentance, and yet somebody must starve. Reckless Istar, non-moral Nature, would have riven the ethical fabric. I was once talking with a very eminent physician [2] about the *vis medicatrix naturoe.* "Stuff!" said he; "nine times out of ten nature does not want to cure the man: she wants to put him in his coffin." And Istar-Nature appears to have equally little sympathy with the ends of society. "Stuff! she wants nothing but a fair field and free play for her darling the strongest."

Our Atlantis may be an impossible figment, but the antagonistic tendencies which the fable adumbrates have existed in every society which was ever established, and, to all appearance, must strive for the victory in all that will be. Historians point to the greed and ambition of rulers, to the reckless turbulence

of the ruled, to the debasing effects of wealth and luxury, and to the devastating wars which have formed a great part of the occupation of mankind, as the causes of the decay of states and the foundering of old civilizations, and thereby point their story with a moral. No doubt immoral motives of all sorts have figured largely among the minor [208] causes of these events. But beneath all this superficial turmoil lay the deep-seated impulse given by unlimited multiplication. In the swarms of colonies thrown out by Phoenicia and by old Greece; in the *ver sacrum* of the Latin races; in the floods of Gauls and of Teutons which burst over the frontiers of tile old civilization of Europe; in the swaying to and fro of the vast Mongolian hordes in late times, the population problem comes to the front in a very visible shape. Nor is it less plainly manifest in the everlasting agrarian questions of ancient Rome than in the Arreoi societies of the Polynesian Islands.

In the ancient world, and in a large part of that in which we live, the practice of infanticide was, or is, a regular and legal custom; famine, pestilence, and war were and are normal factors in the struggle for existence, and they have served, in a gross and brutal fashion, to mitigate the intensity of the effects of its chief cause.

But, in the more advanced civilizations, the progress of private and public morality has steadily tended to remove all these checks. We declare infanticide murder, and punish it as such; we decree, not quite so successfully, that no one shall die of hunger; we regard death from preventible causes of other kinds as a sort of constructive murder, and eliminate pestilence to the best [209] of our ability; we declaim against the curse of war, and the wickedness of the military spirit, and we are never weary of dilating on the blessedness of peace and the innocent beneficence of Industry. In their moments of expansion, even statesmen and men of business go thus far. The finer spirits look to an ideal *civitas Dei;* a state when, every man having reached the point of absolute self-negation, and having nothing but moral perfection to strive after, peace will truly reign, not merely among nations, but among nien, and the struggle for existence will be at an end.

Whether human nature is competent, under any circumstances, to reach, or even seriously advance towards, this ideal condition, is a question which need not be discussed. It will be admitted that mankind has not yet reached this stage by a very long way, and my business is with the present. And that which I wish to point out is that, so long as the natural man increases and multiplies without restraint, so long will peace and industry not only permit, but they will necessitate, a struggle for existence as sharp as any that ever went on under the *regime* of war. If Istar is to reign on the one hand, she will demand her human sacrifices on the other.

Let us look at home. For seventy years peace and industry have had their way among us with less interruption and under more favourable conditions than in any other country on the [210] face of the earth. The wealth of Croesus was nothing to that which we have accumulated, and our prosperity has filled the world with envy. But Nemesis did not forget Croesus: has she forgotten us?

I think not. There are now 36,000,000 of people in our islands, and every year considerably more than 300,000 are added to our numbers. [3] That is to say, about every hundred seconds, or so, a new claimant

to a share in the common stock or maintenance presents him or herself among us. At the present time, the produce of the soil does not suffice to feed half its population. The other moiety has to be supplied with food which must be bought from the people of food-producing countries. That is to say, we have to offer them the things which they want in exchange for the things we want. And the things they want and which we can produce better than they can are mainly manufactures–industrial products.

The insolent reproach of the first Napoleon had a very solid foundation. We not only are, but, under penalty of starvation, we are bound to be, a nation of shopkeepers. But other nations also lie under the same necessity of keeping shop, and some of them deal in the same goods as ourselves. [211] Our customers naturally seek to get the most and the best in exchange for their produce. If our goods are inferior to those of our competitors, there is no ground, compatible with the sanity of the buyers, which can be alloyed, why they should not prefer the latter. And, if that result should ever take place on a large and general scale, five or six millions of us would soon have nothing to eat. We know what the cotton famine was; and we can therefore form some notion of what a dearth of customers would be.

Judged by an ethical standard, nothing can be less satisfactory than the position in which we find ourselves. In a real, though incomplete, degree we have attained the condition of peace which is the main object of social organization; and, for argument's sake, it may be assumed that we desire nothing but that which is in itself innocent and praiseworthy–namely, the enjoyment of the fruits of honest industry. And lo! in spite of ourselves, we are in reality engaged in an internecine struggle for existence with our presumably no less peaceful and well-meaning neighbours. We seek peace and we do not ensue it. The moral nature in us asks for no more than is compatible with the general good; the non-moral nature proclaims and acts upon that fine old Scottish family motto, "Thou shalt starve ere I want." Let us be under no illusions, then. So long as unlimited multiplication goes on, no social organization which has ever been devised, or is [212] likely to be devised, no fiddle-faddling with the distribution of wealth, will deliver society from the tendency to be destroyed by the reproduction within itself, in its intensest form, of that struggle for existence the limitation of which is the object of society. And however shocking to the moral sense this eternal competition of man against man and of nation against nation may be; however revolting may be the accumulation of misery at the negative pole of society, in contrast with that of monstrous wealth at the positive pole; [4] this state of things must abide, and grow continually worse, so long as Istar holds her way unchecked. It is the true riddle of the Sphinx; and every nation which does not solve it will sooner or later be devoured by the monster itself has generated.

The practical and pressing question for us, just now, seems to me to be how to gain time. "Time brings counsel," as the Teutonic proverb has it; and wiser folk among our posterity may see their way out of that which at present looks like an impasse.

It would be folly to entertain any ill-feeling towards those neighbours and rivals who, like

ourselves, are slaves of Istar; but, if somebody is to be starved, the modern world has no Oracle of Delphi to which the nations can appeal for an indication of the victim. It is open to us to try [213] our fortune; and, if we avoid impending fate, there will be a certain ground for believing that we are the right

people to escape. *Securus judicat orbis.*

To this end, it is well to look into the necessary condition of our salvation by works. They are two, one plain to all the world and hardly needing insistence; the other seemingly not so plain, since too often it has been theoretically and practically left out of sight. The obvious condition is that our produce shall be better than that of others. There is only one reason why our goods should be preferred to those of our rivals–our customers must find them better at the price. That means that we must use more knowledge, skill, and industry in producing them, without a proportionate increase in the cost of production; and, as the price of labour constitutes a large element in that cost, the rate of wages must be restricted within certain limits. It is perfectly true that cheap production and cheap labour are by no means synonymous; but it is also true that wages cannot increase beyond a certain proportion without destroying cheapness. Cheapness, then, with, as part and parcel of cheapness, a moderate price of labour, is essential to our success as competitors in the markets of the world.

The second condition is really quite as plainly indispensable as the first, if one thinks seriously about the matter. It is social stability. Society [214] is stable, when the wants of its members obtain as much satisfaction as, life being what it is, common sense and experience show may be reasonably expected. Mankind, in general, care very little for forms of government or ideal considerations of any sort; and nothing really stirs the great multitude to break with custom and incur the manifest perils of revolt except the belief that misery in this world, or damnation in the next, or both, are threatened by the continuance of the state of things in which they have been brought up. But when they do attain that conviction, society becomes as unstable as a package of dynamite, and a very small matter will produce the explosion which sends it back to the chaos of savagery.

It needs no argument to prove that when the price of labour sinks below a certain point, the worker infallibly falls into that condition which the French emphatically call *la misere*–a word for which I do not think there is any exact English equivalent. It is a condition in which the food, warmth, and clothing which are necessary for the mere maintenance of the functions of the body in their normal state cannot be obtained; in which men, women, and children are forced to crowd into dens wherein decency is abolished and the most ordinary conditions of healthful existence are impossible of attainment; in which the pleasures within reach are reduced to bestiality [215] and drunkenness; in which the pains accumulate at compound interest, in the shape of starvation, disease, stunted development, and moral degradation; in which the prospect of even steady and honest industry is a life of unsuccessful battling with hunger, rounded by a pauper's grave.

That a certain proportion of the members of every great aggregation of mankind should constantly tend to establish and populate such a Slough of Despond as this is inevitable, so long as some people are by nature idle and vicious, while others are disabled by sickness or accident, or thrown upon the world by the death of their bread-winners. So long as that proportion is restricted within tolerable limits, it can be dealt with; and, so far as it arises only from such causes, its existence may and must be patiently borne. But, when the organization of society, instead of mitigating this tendency, tends to continue and intensify it; when a given social order plainly makes for evil and not for good, men naturally enough begin to think it high time to try a fresh experiment. The animal man, finding that the ethical man has

landed him in such a slough, resumes his ancient sovereignty, and preaches anarchy; which is, substantially, a proposal to reduce the social cosmos to chaos, and begin the brute struggle for existence once again.

Any one who is acquainted with the state of the population of all great industrial centres, [216] whether in this or other countries, is aware that, amidst a large and increasing body of that population, *La misere* reigns supreme. I have no pretensions to the character of a philanthropist, and I have a special horror of all sorts of sentimental rhetoric; I am merely trying to deal with facts, to some extent within my own knowledge, and further evidenced by abundant testimony, as a naturalist; and I take it to be a mere plain truth that, throughout industrial Europe, there is not a single large manufacturing city which is free from a vast mass of people whose condition is exactly that described; and from a still greater mass who, living just on the edge of the social swamp, are liable to be precipitated into it by any lack of demand for their produce. And, with every addition to the population, the multitude already sunk in the pit and the number of the host sliding towards it continually increase.

Argumentation can hardly be needful to make it clear that no society in which the elements of decomposition are thus swiftly and surely accumulating can hope to win in the race of industries.

Intelligence, knowledge, and skill are undoubtedly conditions of success; but of what avail are they likely to be unless they are backed up by honesty, energy, goodwill, and all the physical and moral faculties that go to the making of manhood, and unless they are stimulated by hope of such reward as men may fairly look to? And what [217] dweller in the slough of want, dwarfed in body and soul, demoralized, hopeless, can reasonably be expected to possess these qualities?

Any full and permanent development of the productive powers of an industrial population, then, must be compatible with and, indeed, based upon a social organization which will secure a fair amount of physical and moral welfare to that population; which will make for good and not for evil. Natural science and religious enthusiasm rarely go hand in hand, but on this matter their concord is complete; and the least sympathetic of naturalists can but admire the insight and the devotion of such social reformers as the late Lord Shaftesbury, whose recently published "Life and Letters" gives a vivid picture of the condition of the working classes fifty years ago, and of the pit which our industry, ignoring these plain truths, was then digging under its own feet.

There is, perhaps, no more hopeful sign of progress among us, in the last half-century, than the steadily increasing devotion which has been and is directed to measures for promoting physical and moral welfare among the poorer classes. Sanitary reformers, like most other reformers whom I have had the advantage of knowing, seem to need a good dose of fanaticism, as a sort of moral coca, to keep them up to the mark, and, doubtless, they have made many mistakes; but that the endeavour to improve the condition under [218] our industrial population live, to amend the drainage of densely peopled streets, to provide baths, washhouses, and gymnasia, to facilitate habits of thrift, to furnish some provision for instruction and amusement in public libraries and the like, is not only desirable from a philanthropic point of view, but an essential condition of safe industrial development, appears to me to be

indisputable. It is by such means alone, so far as I can see, that we can hope to check the constant gravitation of industrial society towards *la misere*, until the general progress of intelligence and morality leads men to grapple with the sources of that tendency. If it is said that the carrying out of such arrangements as those indicated must enhance the cost of production, and thus handicap the producer in the race of competition, I venture, in the first place, to doubt the fact; but if it be so, it results that industrial society has to face a dilemma, either alternative of which threatens destruction.

On the one hand, a population the labour of which is sufficiently remunerated may be physi-

cally and morally healthy and socially stable, but may fail in industrial competition by reason of the dearness of its produce. On the other hand, a population the labour of which is insufficiently remunerated must become physically and morally unhealthy, and socially unstable; and though it may succeed for a while in industrial competition, by reason of the [219] cheapness of its produce, it must in the end fall, through hideous misery and degradation, to utter ruin.

Well, if these are the only possible alternatives, let us for ourselves and our children choose the former, and, if need be, starve like men. But I do not believe that the stable society made up of healthy, vigorous, instructed, and self-ruling people would ever incur serious risk of that fate. They are not likely to be troubled with many competitors of the same character, just yet; and they may be safely trusted to find ways of holding their own.

Assuming that the physical and moral well-being and the stable social order, which are the indispensable conditions of permanent industrial development, are secured, there remains for consideration the means of attaining that knowledge and skill without which, even then, the battle of competition cannot be successfully fought. Let us consider how we stand. A vast system of elementary education has now been in operation among us for sixteen years, and has reached all but a very small fraction of the population. I do not think that there is any room for doubt that, on the whole, it has worked well, and that its indirect no less than its direct benefits have been immense. But, as might be expected, it exhibits the defects of all our educational systems–fashioned as they were to [220] meet the wants of a bygone condition of society. There is a widespread and, I think, well-justified complaint that it has too much to do with books and too little to do with things. I am as little disposed as any one can well be to narrow early education and to make the primary school a mere annexe of the shop. And it is not so much in the interests of industry, as in that of breadth of culture, that I echo the common complaint against the bookish and theoretical character of our primary instruction.

If there were no such things as industrial pursuits, a system of education which does nothing for the faculties of observation, which trains neither the eye nor the hand, and is compatible with utter ignorance of the commonest natural truths, might still be reasonably regarded as strangely imperfect. And when we consider that the instruction and training which are lacking are exactly; those which are of most importance for the great mass of our population, the fault becomes almost a crime, the more that there is no practical difficulty in making good these defects. There really is no reason why drawing should not be universally taught, and it is an admirable training for both eye and hand. Artists are born,

not made; but everybody may be taught to draw elevations, plans, and sections; and pots and pans are as good, indeed better, models for this purpose than the Apollo Belvedere. [221] The plant is not expensive; and there is this excellent quality about drawing of the kind indicated, that it can be tested almost as easily and severely as arithmetic. Such drawings are either right or wrong, and if they are wrong the pupil can be made to see that they are wrong. From the industrial point of view, drawing has the further merit that there is hardly any trade in which the power of drawing is not of daily and hourly utility. In the next place, no good reason, except the want of capable teachers, can be assigned why elementary notions of science should not be an element in general instruction. In this case, again, no expensive or elaborate apparatus is necessary. The commonest thing–a candle, a boy's squirt, a piece of chalk–in the hands of a teacher who knows his business, may be made the starting-point whence children may be led into the regions of science as far as their capacity permits, with efficient exercise of their observational and reasoning faculties on the road. If object lessons often prove trivial failures, it is not the fault of object lessons, but that of the teacher, who has not found out how much the power of teaching a little depends on knowing a great deal, and that thoroughly; and that he has not made that discovery is not the fault of the teachers, but of the detestable system of training them which is widely prevalent. [5]

[222] As I have said, I do not regard the proposal to add these to the present subjects of universal instruction as made merely in the interests of industry. Elementary science and drawing are just as needful at Eton (where I am happy to say both are now parts of the regular course) as in the lowest primary school. But their importance in the education of the artisan is enhanced, not merely by the fact that the knowledge and skill thus gained–little as they may amount to–will still be of practical utility to him; but, further, because they constitute an introduction to that special training which is commonly called "technical education."

I conceive that our wants in this last direction may be grouped under three heads: (1) Instruction in the principles of those branches of science and of art which are peculiarly applicable to industrial pursuits, which may be called preliminary scientific education. (2) Instruction in the special branches of such applied science and art, as technical education proper. (3) Instruction of teachers in both these branches. (I) Capacity-catching machinery.

A great deal has already been done in each of these directions, but much remains to be done.[223] If elementary education is amended in the way that has been suggested, I think that the schoolboards will have quite as much on their hands as they are capable of doing well. The influences under which the members of these bodies are elected do not tend to secure fitness for dealing with scientific or technical education; and it is the less necessary to burden them with an uncongenial task as there are other organizations, not only much better fitted to do the work, but already actually doing it.

In the matter of preliminary scientific education, the chief of these is the Science and Art Department, which has done more during the last quarter of a century for the teaching of elementary science among the masses of the people than any organization which exists either in this or in any other country. It has become veritably a people's university, so far as physical science is concerned. At the foundation of our old universities they were freely open to the poorest, but the poorest must come to them. In the last

quarter of a century, the Science and Art Department, by means of its classes spread all over the country and open to all, has conveyed instruction to the poorest. The University Extension movement shows that our older learned corporations have discovered the propriety of following suit.

Technical education, in the strict sense, has become a necessity for two reasons. The old [224] apprenticeship system has broken down, partly by reason of the changed conditions of industrial life, and partly because trades have ceased to be "crafts," the traditional secrets whereof the master handed down to his apprentices. Invention is constantly changing the face of our industries, so that "use and wont," "rule of thumb," and the like, are gradually losing their importance, while that knowledge of principles which alone can deal successfully with changed conditions is becoming more and more valuable. Socially, the "master" of four or five apprentices is disappearing in favour of the "employer" of forty, or four hundred, or four thousand, "hands," and the odds and ends of technical knowledge, formerly picked up in a shop, are not, and cannot be, supplied in the factory. The instruction formerly given by the master must therefore be more than replaced by the systematic teaching of the technical school.

Institutions of this kind on varying scales of magnitude and completeness, from tile splendid edifice set up by the City and Guilds Institute to the smallest local technical school, to say nothing of classes, such as those in technology instituted by the Society of Arts (subsequently taken over by the City Guilds), have been established in various parts of the country, and the movement in favour of their increase and multiplication is rapidly growing in breadth and intensity. But [225] there is much difference of opinion as to the best way in which the technical instruction, so generally desired, should be given. Two courses appear to be practicable: the one is the establishment of special technical schools with a systematic and lengthened course of instruction demanding the employment of the whole time of the pupils. The other is the setting afoot of technical classes, especially evening classes, comprising a short series of lessons on some special topic, which may be attended by persons already earning wages in some branch of trade or commerce.

There is no doubt that technical schools, on the plan indicated under the first head, are extremely costly; and, so far as the teaching of artisans is concerned, it is very commonly objected to them that, as the learners do not work under trade conditions, they are apt to fall into amateurish habits, which prove of more hindrance than service in the actual business of life. When such schools are attached to factories under the direction of an employer who desires to train up a supply of intelligent workmen, of course this objection does not apply; nor can the usefulness of such schools for the training of future employers and for the higher grade of the employed be doubtful; but they are clearly out of the reach of the great mass of the people, who have to earn their bread as soon as possible. We must therefore look to the classes, and especially to [226] evening classes, as the great instrument for the technical education of the artisan. The utility of such classes has now been placed beyond all doubt; the only question which remains is to find the ways and means of extending them.

We are here, as in all other questions of social organization, met by two diametrically opposed views. On the one hand, the methods pursued in foreign countries are held up as our example. The State is

exhorted to take the matter in hand. and establish a great system of technical education. On the other hand, many economists of the individualist school exhaust the resources of language in condemning and repudiating, not merely the interference of the general government in such matters, but the application of a farthing of the funds raised by local taxation to these purposes. I entertain a strong conviction that, in this country, at any rate, the State had much better leave purely technical and trade instruction alone. But, although my personal leanings are decidedly towards the individualists, I have arrived at that conclusion on merely practical grounds. In fact, my individualism is rather of a sentimental sort, and I sometimes think I should be stronger in the faith if it were less vehemently advocated. [6] I am unable to see that civil society [227] is anything but a corporation established for a moral object only–namely, the good of its members–and therefore that it may take such measures as seem fitting for the attainment of that which the general voice decides to be the general good. That the suffrage of the majority is by no means a scientific test of social good and evil is unfortunately too true; but, in practice, it is the only test we can apply, and the refusal to abide by it means anarchy. The purest despotism that ever existed is as much based upon that will of the majority (which is usually submission to the will of a small minority) as the freest republic. Law is the expression of the opinion of the majority; and it is law, and not mere opinion, because the many are strong enough to enforce it.

I am as strongly convinced as the most pronounced individualist can be, that it is desirable that every man should be free to act in every way which does not limit the corresponding freedom of his fellow-man. But I fail to connect that great induction of political science with the practical corollary which is frequently drawn from it: that the State–that is, the people in their corporate capacity–has no business to meddle with anything but the administration of justice and external defence. It appears to me that the [228] amount of freedom which incorporate society may fitly leave to its members is not a fixed quantity, to be determined *a priori* by deduction from the fiction called "natural rights"; but that it must be determined by, and vary with, circumstances. I conceive it to be demonstrable that the higher and the more complex the organization of the social body, the more closely is the life of each member bound up with that of the whole; and the larger becomes the category of acts which cease to be merely self-regarding, and which interfere with the freedom of others more or less seriously.

If a squatter, living ten miles away from any neighbour, chooses to burn his house down to get rid of vermin, there may be no necessity (in the absence of insurance offices) that the law should interfere with his freedom of action; his act can hurt nobody but himself. But, if the dweller in a street chooses to do the same thing, the State very properly makes such a proceeding a crime, and punishes it as such. He does meddle with his neighbour's freedom, and that seriously. So it might, perhaps, be a tenable doctrine, that it would be needless, and even tyrannous, to make education compulsory in a sparse agricultural population, living in abundance on the produce of its own soil; but, in a densely populated manufacturing country, struggling for existence with competitors, every ignorant person tends to [229] become a burden upon, and, so far, an infringer of the liberty of, his fellows, and an obstacle to their success. Under such circumstances an education rate is, in fact, a war tax, levied for purposes of defence.

That State action always has been more or less misdirected, and always will be so, is, I believe, perfectly true. But I am not aware that it is more true of the action of men in their corporate capacity than it is of the doings of individuals. The wisest and most dispassionate man in existence, merely wishing to go

from one stile in a field to the opposite, will not walk quite straight–he is always going a little wrong, and always correcting himself; and I can only congratulate the individualist who is able to say that his general course of life has been of a less undulatory character. To abolish State action, because its direction is never more than approximately correct, appears to me to be much the same thing as abolishing the man at the wheel altogether, because, do what he will, the ship yaws more or less. "Why should I be robbed of my property to pay for teaching another man's children?" is an individualist question, which is not unfrequently put as if it settled the whole business. Perhaps it does, but I find difficulties in seeing why it should. The parish in which I live makes me pay my share for the paving and lighting of a great many streets that I never pass through; [230] and I might plead that I am robbed to smooth the way and lighten the darkness of other people. But I am afraid the parochial authorities would not let me off on this plea; and I must confess I do not see why they should.

I cannot speak of my own knowledge, but I have every reason to believe that I came into this world a small reddish person, certainly without a gold spoon in my mouth, and in fact with no discernible abstract or concrete "rights" or property of any description. If a foot was not set upon me, at once, as a squalling nuisance, it was either the natural affection of those about me, which I certainly had done nothing to deserve, or the fear of the law which, ages before my birth, was painfully built up by the society into which I intruded, that prevented that catastrophe. If I was nourished, cared for, taught, saved from the vagabondage of a wastrel, I certainly am not aware that I did anything to deserve those advantages. And, if I possess anything now, it strikes me that, though I may have fairly earned my day's wages for my day's work, and may justly call them my property–yet, without that organization of society, created out of the toil and blood of long generations before my time, I should probably have had nothing but a flint axe and an indifferent hut to call my own; and even those would be mine only so long as no stronger savage came my way.

So that if society, having, quite gratuitously, [231] done all these things for me, asks me in turn to do something towards its preservation–even if that something is to contribute to the teaching of other men's children–I really in spite of all my individualist leanings, feel rather ashamed to say no. And if I were not ashamed, I cannot say that I think that society would be dealing unjustly with me in converting the moral obligation into a legal one. There is a manifest unfairness in letting all the burden be borne by the willing horse.

It does not appear to me, then, that there is any valid objection to taxation for purposes of education; but, in the case of technical schools and classes, I think it is practically expedient that such a taxation should be local. Our industrial population accumulates in particular towns and districts; these districts are those which immediately profit by technical education; and it is only in them that we can find the men practically engaged in industries, among whom some may reasonably be expected to be competent judges of that which is wanted, and of the best means of meeting the want.

In my belief, all methods of technical training are at present tentative, and, to be successful, each must be adapted to the special peculiarities of its locality. This is a case in which we want twenty years, not of strong government," but of cheerful and hopeful blundering; and we may be [232] thankful if we act things straight in that time.

The principle of the Bill introduced, but dropped, by the Government last session, appears to me to be wise, and some of the objections to it I think are due to a misunderstanding. The bill proposed in substance to allow localities to tax themselves for purposes of technical education–on the condition that any scheme for such purpose should be submitted to the Science and Art Department, and declared by that department to be in accordance with the intention of the Legislature.

A cry was raised that the Bill proposed to throw technical education into the hands of the Science and Art Department. But, in reality, no power of initiation, nor even of meddling with details, was given to that Department–the sole function of which was to decide whether any plan proposed did or did not come within the limits of "technical education." The necessity for such control, somewhere, is obvious.: No legislature, certainly not ours, is likely to grant the power of self-taxation without setting limits to that power in some way; and it would neither have been practicable to devise a legal definition of technical education, nor commendable to leave the question to the Auditor-General, to be fought out in the law-courts. The only alternative was to leave the decision to an appropriate State authority. If it is asked what is the need of such control if the people of [233] the localities are the best judges, the obvious reply is that there are localities and localities, and that while Manchester, or Liverpool, or Birmingham, or Glasgow might, perhaps, be safely left to do as they thought fit, smaller towns, in which there is less certainty of full discussion by competent people of different ways of thinking, might easily fall a prey to crocheteers.

Supposing our intermediate science teaching and our technical schools and classes are established, there is yet a third need to be supplied, and that is the want of good teachers. And it is necessary not only to get them, but to keep them when you have got them.

It is impossible to insist too strongly upon the fact that the efficient teachers of science and of technology are not to be made by the processes in vogue at ordinary training colleges. The memory loaded with mere bookwork is not the thing wanted–is, in fact, rather worse than useless–in the teacher of scientific subjects. It is absolutely essential that his mind should be full of knowledge and not of mere learning, and that what he knows should have been learned in the laboratory rather than in the library. There are happily already, both in London and in the provinces, various places in which such training is to be had, and the main thing at present is to make it in the first place accessible, and in the next indispensable, to those who undertake the business of teaching. [234] But when the well-trained men are supplied, it must be recollected that the profession of teacher is not a very lucrative or otherwise tempting one, and that it may be advisable to offer special inducements to good men to remain in it. These, however, are questions of detail into which it is unnecessary to enter further.

Last, but not least, comes the question of providing the machinery for enabling those who are by nature specially qualified to undertake the higher branches of industrial work, to reach the position in which they may render that service to the community. If all our educational expenditure did nothing but pick one man of scientific or inventive genius, each year, from amidst the hewers of wood and drawers of water, and give him the chance of making the best of his inborn faculties, it would be a very good

investment. If there is one such child among the hundreds of thousands of our annual increase, it would be worth any money to drag him either from the slough of misery, or from the hotbed of wealth, and teach him to devote himself to the service of his people. Here, again, we have made a beginning with our scholarships and the like, and need only follow in the tracks already worn.

The programme of industrial development briefly set forth in the preceding pages is not what Kant calls a "Hirngespinnst," a cobweb spun in the brain of a Utopian philosopher. More [235] or less of it has taken bodily shape in many parts of the country, and there are towns of no great size or wealth in the manufacturing districts (Keighley, for example) in which almost the whole of it has, for some time, been carried out, so far as the means at the disposal of the energetic and public-spirited men who have taken the matter in hand permitted. The thing can be done; I have endeavoured to show good grounds for the belief that it must be done, and that speedily, if we wish to hold our own in the war of industry. I doubt not that **it** will be done, whenever its absolute necessity becomes as apparent to all those who are absorbed in the actual business of industrial life as it is to some of the lookers on.

Perhaps it is necessary for me to add that technical education is not here proposed as a panacea for social diseases, but simply as a medicament which will help the patient to pass through an imminent crisis.

An ophthalmic surgeon may recommend an operation for cataract in a man who is going blind, without being supposed to undertake that it will cure him of gout. And I may pursue the metaphor so far as to remark, that the surgeon is justified in pointing out that a diet of pork-chops and burgundy will probably kill his patient, though he may be quite able to suggest a mode [236] of living which will free him from his constitutional disorder.

Mr. Booth asks me, Why do you not propose some plan of your own? Really, that is no answer to my argument that his treatment will make the patient very much worse. [Note added in *Social Diseases and Worse Remedies*, January, 1891.]

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1 [The reader will observe that this is the argument of the Romanes Lecture, in brief–1894.]

2 The late Sir W. Gull.

3 These numbers are only approximately accurate. In 1881, our population amounted to 35,241,482, exceeding the number in 1871 by 3,396,103. The average annual increase in the decennial period 1871-1881 is therefore 339,610. The number of minutes in a calendar year is 525,600.

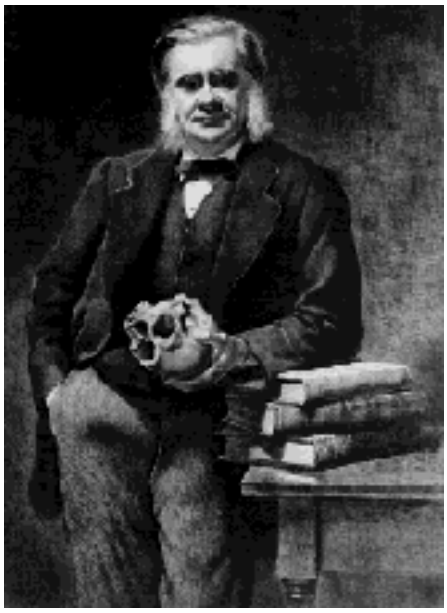
4 [It is hard to say whether the increase of the unemployed poor, or that of the unemployed rich, is the greater social evil.–1894.]

5 Training in the use of simple tools is no doubt very desirable, on all grounds. From the point of view

of "culture," the man whose "fingers are all thumbs" is but a stunted creature. But the practical difficulties in the way of introducing handiwork of this kind into elementary schools appear to me to be considerable.

6 In what follows I am only repeating and emphasizing opinions which I expressed seventeen years ago, in an Address to the members of the Midland Institute (republished *in Critiques and*

Addresses in 1873, and in Vol. I. of these *Essays*). I have seen no reason to modify them, notwithstanding high authority on the other side.



Darkest England Scheme (1890)

Collected Essays IX

I
The "Times," December 1*st*, 1890

[237] Sir,–A short time ago a generous and philanthropic friend wrote to me, placing at my disposal a large sum of money for the furtherance of the vast scheme which the "General" of the Salvation Army has propounded, if I thought it worthy of support. The responsibility of advising my benevolent correspondent has weighed heavily upon me, but I felt that it would be cowardly, as well as ungracious, to refuse to accept it. I have therefore studied Mr. Booth's book with some care, for the purpose of separating the essential from the accessory features of his project, and I have based my judgment–I am sorry to say an unfavourable one–upon the *data* thus obtained. Before communicating my conclusions to my friend, however, I am desirous to know what there may be to be said in arrest of that judg[238]ment; and the matter is of such vast public importance that I trust you will aid me by publishing this letter, notwithstanding its length.

There are one or two points upon which I imagine all thinking men have arrived at the same convictions as those from which Mr. Booth starts. It is certain that there is an immense amount of remediable misery among us, that, in addition to the poverty, disease, and degradation which are the consequences of causes beyond human control, there is a vast, probably a very much larger, quantity of misery which is the result of individual ignorance, or misconduct, and of faulty social arrangements. Further, I think it is not to be doubted that, unless this remediable misery is effectually dealt with, the hordes of vice and pauperism will destroy modern civilization as effectually as uncivilized tribes of another kind destroyed the great social organization which preceded ours. Moreover, I think all will agree that no reforms and improvements will go to the root of the evil unless they attack it in its ultimate source–namely, the motives of the individual man. Honest, industrious, and self-restraining men will make a very bad social organization prosper; while vicious, idle, and reckless citizens will bring to ruin the best that ever was, or ever will be, invented.

The leading propositions which are peculiar to Mr. Booth I take to be these:–

[239] (1) That the only adequate means to such reformation of the individual man is the adoption of that form of somewhat corybantic Christianity of which the soldiers of the Salvation Army are the militant missionaries. This implies the belief that the excitement of the religious emotions (largely by processes described by their employers as "rousing" and "convivial") is a desirable and trustworthy method of permanently amending the conduct of mankind.

I demur to these propositions. I am of opinion that the testimony of history, no less than the cool observation of that which lies within the personal experience of many of us, is wholly adverse to it.

(2) That the appropriate instrument for the propagation and maintenance of this peculiar sacramental enthusiasm is the Salvation Army–a body of devotees, drilled and disciplined as a military organization, and provided with a numerous hierarchy of officers, every one of whom is pledged to blind and unhesitating obedience to the "General," who frankly tells us that the first condition of the service is "implicit, unquestioning obedience." "A telegram from me will send any of them to the uttermost parts of the earth"; every one "has taken service on the express condition that he or she will obey, without questioning, or gainsaying, the orders from headquarters" ("Darkest England," p. 243).

[240] This proposition seems to me to be indisputable. History confirms it. Francis of Assisi and Ignatius Loyola made their great experiments on the same principle. Nothing is more certain than that a body of religious enthusiasts (perhaps we may even say fanatics) pledged to blind obedience to their chief, is one of the most efficient instruments for effecting any purpose that the wit of man has yet succeeded in devising. And I can but admire the insight into human nature which has led Mr. Booth to leave his unquestioning and unhesitating instruments unbound by vows. A volunteer slave is worth ten sworn bondsmen.

(3) That the success of the Salvation Army, with its present force of 9416 officers "wholly engaged in the work," its capital of three quarters of a million, its income of the same amount, its 1375 corps at home, and 1499 in the colonies and foreign countries (Appendix, pp. 3 and 4), is a proof that Divine assistance has been vouchsafed to its efforts.

Here I am not able to agree with the sanguine Commander-in-chief of the new model, whose labours in creating it have probably interfered with his acquisition of information respecting the fate of previous enterprises of like kind.

It does not appear to me that his success is in any degree more remarkable than that of Francis of Assisi or that of Ignatius Loyola, than that [241] of George Fox, or even than that of the Mormons, in our own time. When I observe the discrepancies of the doctrinal foundations from which each of these great movements set out, I find it difficult to suppose that supernatural aid has been given to all of them; still more, that Mr. Booth's smaller measure of success is evidence that it has been granted to him.

But what became of the Franciscan experiment[1]? If there was one rule rather than another on which the founder laid stress, it was that his army of friars should be absolute mendicants, keeping themselves sternly apart from all worldly entanglements. Yet, even before the death of Francis, in 1226, a strong party, headed by Elias of Cortona, the deputy of his own appointment, began to hanker after these very things; and, within thirty years of that time, the Franciscans had become one of the most powerful, wealthy, and worldly corporations in Christendom, with their fingers in every sink of political and social corruption, if so be profit for the order could be fished out of it; their principal interest being to fight their rivals, the Dominicans, and to persecute such of their own brethren as were honest enough to try to carry out their founder's plainest injunctions. We also know what has become of Loyola's experiment. For two centuries the Jesuits have been the hope of the enemies of the Papacy; [242] whenever it

becomes too prosperous, they are sure to bring about a catastrophe by their corrupt use of the political and social influence which their organization and their wealth secure.

With these examples of that which may happen to institutions founded by noble men, with high aims, in the hands of successors of a different stamp, armed with despotic authority, before me, common prudence surely requires that, before advising the handing over of a large sum of money to the general of a new order of mendicants, I should ask what guarantee there is that, thirty years hence, the "General" who then autocratically controls the action, say, of 100,000 officers pledged to blind obedience, distributed through the whole length and breadth of the poorer classes, and each with his finger on the trigger of a mine charged with discontent and religious fanaticism; with the absolute control, say, of eight or ten millions sterling of capital and as many of income; with barracks in every town, with estates scattered over the country, and with settlements in the colonies–will exercise his enormous powers, not merely honestly, but wisely? What shadow of security is there that the person who wields this uncontrolled authority over many thousands of men shall use it solely for those philanthropic and religious objects which, I do not doubt, are alone in the mind of Mr. Booth? Who is to say that the Salvation Army, in the year [243] 1920, shall not be a replica of what the Franciscan order had become in the year 1260?

The personal character and the intentions of the founders of such organizations as we are considering count for very little in the formation of a forecast of their future; and if they did, it is no disrespect to Mr. Booth to say that he is not the peer of Francis of Assisi. But if Francis's judgment of men was so imperfect as to permit him to appoint an ambitious intriguer of the stamp of Brother Elias his deputy, we have no right to be sanguine about the perspicacity of Mr. Booth in a like matter.

Adding to all these considerations the fact that Mr. Llewelyn Davies, the warmth of whose philanthropy is beyond question, and in whose competency and fairness I, for one, place implicit reliance, flatly denies the boasted success of the Salvation Army in its professed mission, I have arrived at the conclusion that, as at present advised, I cannot be the instrument of carrying out my friend's proposal.

Mr. Booth has pithily characterized certain benevolent schemes as doing sixpennyworth of good and a shilling's worth of harm. I grieve to say that, in my opinion, the definition exactly fits his own project. Few social evils are of greater magnitude than uninstructed and unchastened religious fanaticism; no personal habit more surely degrades the conscience and the intellect [244] than blind and unhesitating obedience to unlimited authority. Undoubtedly, harlotry and intemperance are sore evils, and starvation is hard to bear, or even to know of; but the prostitution of the mind, the soddening of the conscience, the dwarfing of manhood are worse calamities. It is a greater evil to have the intellect of a nation put down by organized fanaticism; to see its political and industrial affairs at the mercy of a despot whose chief thought is to make that fanaticism prevail; to watch the degradation of men, who should feel themselves individually responsible for their own and their country's fates, to mere brute instruments, ready to the hand of a master for any use to which he may put them.

But that is the end to which, in my opinion, all such organizations as that to which kindly people, who

do not look to the consequences of their acts, are now giving their thousands, inevitably tend. Unless clear proof that I am wrong is furnished, another thousand shall not be added by my instrumentality.

I am, Sir, your obedient servant,
T. H. Huxley.

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[1] See note pp. 245-47.

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[245] NOTE.

An authoritative contemporary historian, Matthew Paris, writes thus of the Minorite, or Franciscan, Friars in England in 1235, just nine years after the death of Francis of Assisi:–

"At this time some of the Minorite brethren, as well as some of the Order of Preachers, unmindful of their profession and the restrictions of their order, impudently entered the territories of some noble monasteries, under pretense of fulfilling their duties of preaching, as if intending to depart after preaching the next day. Under pretence of sickness, or on some other pretext, however, they remained, and, constructing an altar of wood, they placed on it a consecrated stone altar, which they had brought with them, and clandestinely and in a low voice performed mass, and even received the confessions of many of the parishioners, to the prejudice of the priests.... And if by chance they were not satisfied with this, they broke forth in insults and threats, reviling every other order except their own, and asserting that all the rest were doomed to damnation, and that they would not spare the soles of their feet till they had exhausted the wealth of their opposers, however great it might be. The religious men, therefore, gave way to them in many points, yielding to avoid scandal, and offending those in power. For they were the councillors and messengers of the nobles, and even secretaries of the Pope, and therefore obtained much [246] secular favour. Some, however, finding themselves opposed at the Court of Rome, were restrained by obvious reasons, and went away in confusion; for the Supreme Pontiff, with a scowling look, said to them, 'What means this, my brethren? To what lengths are you going? Have you not professed voluntary poverty, and that you would traverse towns and castles and distant places, as the case required, barefooted and unostentatiously in order to preach the word of God in all humility? And do you now presume to usurp these estates to yourselves against the will of the lords of these fees? Your religion appears to be in a great measure dying away, and your doctrines to be confuted.'"

Under date of 1243, Matthew writes:–

"For three or four hundred years or more the monastic order did not hasten to destruction so quickly as their order [Minorites and Preachers] of whom now the brothers, twenty-four years having scarcely elapsed, had first built in England dwellings which rivalled regal palaces in height. These are they who daily expose to view their inestimable treasures, in enlarging their sumptuous edifices, and erecting lofty walls, thereby impudently transgressing the limits of their original poverty and violating the basis of their religion, according to the prophecy of German Hildegarde. When noblemen and rich men are at the point of death, whom they know to be

possessed of great riches, they, in their love of gain, diligently urge them, to the injury and loss of the ordinary pastors, and extort confessions and hidden wills, lauding themselves and their own order only, [247] and placing themselves before all others. So no faithful man now believes he can be saved, except he is directed by the counsels of the Preachers and Minorites."–Matthew Paris's *English History.* Translated by the Rev. J. A. Giles, 1889, Vol. I.

II

The "Times," December 9*th*, 1890

Sir,–The purpose of my previous letter about Mr. Booth's scheme was to arouse the contributors to the military chest of the Salvation Army to a clear sense of what they are doing. I thought it desirable that they should be distinctly aware that they are setting up and endowing a sect, in many ways analogous to the "Ranters" and "Revivalists" of undesirable notoriety in former times; but with this immensely important difference, that it possesses a strong, far-reaching, centralized organization, the disposal of the physical, moral, and financial strength of which rests with an irresponsible chief, who, according to his own account, is assured of the blind obedience of nearly 10,000 subordinates. I wish them to ask themselves, Ought prudent men and good citizens to aid in the establishment of an organization which, under sundry, by no means improbable, contingencies may easily become a worse and [248] more dangerous nuisance than the mendicant friars of the middle ages? If this is an academic question, I really do not know what questions deserve to be called practical. As you divined, I purposely omitted any consideration of the details of the Salvationist scheme, and of the principles which animate those who work it, because I desired that the public appreciation of the evils, necessarily inherent in all such plans of despotic social and religious regimentation should not be obscured by the raising of points of less comparative, however great absolute, importance.

But it is now time to undertake a more particular criticism of "Darkest England." At the outset of my examination of that work, I was startled to find that Mr. Booth had put forward his scheme with an almost incredibly imperfect knowledge of what had been done and is doing in the same direction. A simple reader might well imagine that the author of "Darkest England" posed as the Columbus, or at any rate the Cortez, of that region. "Go to Mudie's," he tells us, and you will be surprised to see how few books there are upon the social problem. That may or may not be correct; but if Mr. Booth had gone to a certain reading-room not far from Mudie's, I undertake to say that the well-informed and obliging staff of the national library in Bloomsbury would have provided him with more books on this topic, in almost all European languages, than he would [249] read in three months. Has socialism no literature? And what is socialism but an incarnation of the social question? Moreover, I am persuaded that even "Studied" resources could have furnished Mr. Booth with the "Life of Lord Shaftesbury" and Carlyle's works. Mr. Booth seems to have undertaken to instruct the world without having heard of "Past and Present" or of "Latter-Day Pamphlets"; though, somewhat late in the day, a judicious friend calls his attention to them. To those of my contemporaries on whom, as on myself, Carlyle's writings on this topic made an ineffaceable impression forty years ago, who know that, for all that time, hundreds of able and devoted men, both clerical and lay, have worked heart and soul for the permanent amendment of the condition of the poor, Mr. Booth's "Go to Mudie's" affords an apt measure of the depth of his preliminary studies. However, I am bound to admit that these earlier labourers in the field laboured in

such a different fashion, that the originality of the plan started by Mr. Booth remains largely unaffected. For them no drums have beat, no trombones brayed; no sanctified buffoonery, after the model of the oration of the Friar in Wallenstein's camp dear to the readers of Schiller, has tickled the ears of the groundlings on their behalf. Sadly behind the great age of rowdy self-advertisement in which their lot has fallen, they seem not to have advanced one whit beyond John the [250] Baptist and the Apostles, 1800 years ago, in their notions of the way in which the *metanoia*, the change of mind of the ill-doer, is to be brought about. Yet the new model was there, ready for the imitation of those ancient savers of souls. The ranting and roaring mystagogues of some of the most venerable of Greek and Syrian cults also had their processions and banners, their fifes and cymbals and holy chants, their hierarchy of officers to whom the art of making collections was not wholly unknown; and who, as freely as their modern imitators, promised an Elysian future to contributory converts. The success of these antique Salvation armies was enormous. Simon Magus was quite as notorious a personage, and probably had as strong a following as Mr. Booth. Yet the Apostles, with their old-fashioned ways, would not accept such a success as a satisfactory sign of the Divine sanction, nor depart from their own methods of leading the way to the higher life.

I deem it unessential to verify Mr. Booth's statistics. The exact strength of the population of the realm of misery, be it one, two, or three millions, has nothing to do with the efficacy of any means proposed for the highly desirable end of reducing it to a *minimum* . The sole question for consideration at present is whether the scheme, keeping specially in view the spirit in which it is to be worked, is likely to do more good than harm.

[251] Mr. Booth tells us, with commendable frankness, that "it is primarily and mainly for the sake of saving the soul that I seek the salvation of the body" (p. 45), which language, being interpreted, means that the propagation of the special Salvationist creed comes first, and the promotion of the physical, intellectual, and purely moral welfare of mankind second in his estimation. Men are to be made sober and industrious, mainly, that, as washed, shorn, and docile sheep, they may be driven into the narrow theological fold which Mr. Booth patronizes. If they refuse to enter, for all their moral cleanliness, they will have to take their place among the goats as sinners, only less dirty than the rest.

I have been in the habit of thinking (and I believe the opinion is largely shared by reasonable men) that self-respect and thrift are the rungs of the ladder by which men may most surely climb out of the slough of despond of want; and I have regarded them as perhaps the most eminent of the practical virtues. That is not Mr. Booth's opinion. For him they are mere varnished sins–nothing better than "Pride re-baptised" (p. 46). Shutting his eyes to the necessary consequences of the struggle for life, the existence of which he accepts as fully as any Darwinian,[1] Mr. Booth tells men, whose evil case is one of those consequences, that envy is a corner-stone of our [252] competitive system. With thrift and self-respect denounced as sin, with the suffering of starving men referred to the sins of the capitalist, the gospel according to Mr. Booth may save souls, but it will hardly save society.

In estimating the social and political influence which the Salvation Army is likely to exert, it is important to reflect that the officers (pledged to blind obedience to their "General") are not to confine

themselves to the functions of mere deacons and catechists (though, under a "General" like Cyril, Alexandria knew to her cost what even they could effect); they are to be "tribunes of the people," who are to act as their gratuitous legal advisers; and, when law is not sufficiently effective, the whole force of the army is to obtain what the said tribunes may conceive to be justice, by the practice of ruthless intimidation. Society, says Mr. Booth, needs "mothering"; and he sets forth, with much complacency, a variety of "cases," by which we may estimate the sort of "mothering" to be expected at his parental hands. Those who study the materials thus set before them will, I think, be driven to the conclusion that the "mother" has already proved herself a most unscrupulous meddler, even if she has not fallen within reach of the arm of the law.

Consider this "case." A, asserting herself to have been seduced twice, "applied to our people. [253] We hunted up the man, followed him to the country, threatened him with public exposure, and forced from him the payment to his victim of £60 down, an allowance of £1 a week, and an insurance policy on his life for £450 in her favour" (p. 222).

Jedburgh justice this. "We" constitute ourselves prosecutor, judge, jury, sheriff's officer, all in one; "we" practice intimidation as deftly as if we were a branch of another League; and, under threat of exposure, "we" extort a tolerably heavy hush-money in payment of our silence.

Well, really, my poor moral sense is unable to distinguish these remarkable proceedings of the new popular tribunate from what, in French, is called *chantage* and, in plain English, blackmailing. And when we consider that anybody, for any reason of jealousy, or personal spite, or party hatred, might be thus "hunted," "followed," "threatened," and financially squeezed or ruined, without a particle of legal investigation, at the will of a man whom the familiar charged with the inquisitorial business dare not hesitate to obey, surely it is not unreasonable to ask how far does the Salvation Army, in its "tribune of the people" aspect, differ from a Sicilian Mafia? I am no apologist of men guilty of the acts charged against the person who yet, I think, might be as fairly called a "victim," in this case, as his partner in wrong-doing. It is possible that, in so peculiar [254] a case, Solomon himself might have been puzzled to apportion the relative moral delinquency of the parties. However that may be, the man was morally and legally bound to support his child, and any one would have been justified in helping the woman to her legal rights, and the man to the legal consequences (in which exposure is included) of his fault.

The action of the "General" of the Salvation Army in extorting the heavy fine he chose to impose as the price of his silence, however excellent his motives, appears to me to be as immoral as, I hope, it is illegal.

So much for the Salvation Army as a teacher of questionable ethics and of eccentric economics, as the legal adviser who recommends and practices the extraction of money by intimidation, as the fairy godmother who proposes to "mother" society, in a fashion which is not to my taste, however much it may commend itself to some of Mr. Booth's supporters.

I am, Sir, your obedient servant,
T. H. Huxley.

[1] See p. 100.

III

The "Times," December 11*th*, 1890

[255] Sir,–When I first addressed you on the subject of the projected operations of the Salvation Army, all that I knew about that body was derived from the study of Mr. Booth's book, from common repute, and from occasional attention to the sayings and doings of his noisy squadrons, with which my walks about London, in past years, have made me familiar. I was quite unaware of the existence of evidence respecting the present administration of the Salvation forces, which would have enabled me to act upon the sagacious maxim of the American humourist, "Don't prophesy unless you know." The letter you were good enough to publish has brought upon me a swarm of letters and pamphlets. Some favour me with abuse; some thoughtful correspondents warmly agree with me, and then proceed to point out how much worthier certain schemes of their own are of my friend's support; some send valuable encouragement, for which I offer my hearty thanks, and ask them to excuse any more special acknowledgment. But that which I find most to the purpose, just now, is the revelation made by some of the documents which have reached me, of a fact of which I was [256] wholly ignorant–namely, that persons who have faithfully and zealously served in the Salvation Army, who express unchanged attachment to its original principles and practice, and who have been in close official relations with the "General" have publicly declared that the process of degradation of the organization into a mere engine of fanatical intolerance and personal ambition, which I declared was inevitable, has already set in and is making rapid progress.

It is out of the question, Sir, that I should occupy the columns of the "Times" with a detailed exposition and criticism of these *pièces justificatives* of my forecast. I say criticism, because the assertions of persons who have quitted any society must, in fairness, be taken with the caution that is required in the case of all *ex parte* statements of hostile witnesses. But it is, at any rate, a notable fact that there are parts of my first letter, indicating the inherent and necessary evil consequences of any such organization, which might serve for abstracts of portions of this evidence, long since printed and published under the public responsibility of the witnesses.

Let us ask the attention of your readers, in the first place, to "An ex-Captain's Experience of the Salvation Army," by J. J. R. Redstone, the genuineness of which is guaranteed by the preface (dated April 5th, 1888) which the Rev. Dr. Cunningham Geikie has supplied. Mr. Redstone's [257] story is well worth reading on its own account. Told in simple, direct language such as John Bunyan might have used, it permits no doubt of the single-minded sincerity of the man, who gave up everything to become an officer of the Salvation Army, but, exhibiting a sad want of that capacity for unhesitating and blind obedience on which Mr. Booth lays so much stress, was thrown aside, penniless–no, I am wrong, with

2*s.* 4*d.* for his last week's salary–to shift, with his equally devoted wife, as he best might. I wish I could induce intending contributors to Mr. Booth's army chest to read Mr. Redstone's story. I would particularly ask them to contrast the pure simplicity of his plain tale with the artificial pietism and slobbering unction of the letters which Mr. Ballington Booth addresses to his "dear boy" (a married man apparently older than himself), so long as the said "dear boy" is facing brickbats and starvation, as per order.

I confess that my opinion of the chiefs of the Salvation Army has been so distinctly modified by the perusal of this pamphlet that I am glad to be relieved from the necessity of expressing it. It will be much better that I should cite a few sentences from the preface written by Dr. Cunningham Geikie, who expresses warm admiration for the early and uncorrupted work of the Salvation Army, and cannot possibly be accused of prejudice against it on religious grounds:–

[258] (1) "The Salvation Army 'is emphatically a family concern. Mr. Booth, senior, is General; one son is chief of the staff, and the remaining sons and daughters engross the other chief positions. It is Booth all over; indeed, like the sun in your eyes, you can see nothing else wherever you turn.' And, as Dr. Geikie shrewdly remarks, 'to be the head of a widely spread sect carries with it many advantages–not all exclusively spiritual.'"

(2) "Whoever becomes a Salvation officer is henceforth a slave, helplessly exposed to the caprice of his superiors."

"Mr. Redstone bore an excellent character both before he entered the army and when he left it. To join it, though a married man, he gave up a situation which he had held for five years, and he served Mr. Booth two years, working hard in most difficult posts. His one fault, Major Lawley tells us, was, that he was 'too straight'–that is, too honest, truthful, and manly–or, in other words, too real a Christian. Yet without trial, without formulated charges, on the strength of secret complaints which were never, apparently, tested, he was dismissed with less courtesy than most people would show a beggar–with 2*s.* 4*d.* for his last week's salary. If there be any mistake in this matter, I shall be glad to learn it."

(3) Dr. Geikie confirms, on the ground of information given confidentially by other officers, [259] Mr. Redstone's assertion that they are watched and reported by spies from headquarters.

(4) Mr. Booth refuses to guarantee his officers any fixed amount of salary. While he and his family of high officials live in comfort, if not in luxury, the pledged slaves whose devotion is the foundation of any true success the Army has met with often have "hardly food enough to sustain life. One good fellow frankly told me that when he had nothing he just went and begged."

At this point, it is proper that I should interpose an apology for having hastily spoken of such men as Francis of Assisi, even for purposes of warning, in connection with Mr. Booth. Whatever may be thought of the wisdom of the plans of the founders of the great monastic orders of the middle ages, they took their full share of suffering and privation, and never shirked in their own persons the sacrifices they

imposed on their followers.

I have already expressed the opinion, that whatever the ostensible purpose of the scheme under discussion, one of its consequences will be the setting up and endowment of a new Ranter-Socialist sect. I may now add that another effect will be–indeed, has been–to set up and endow the Booth dynasty with unlimited control of the physical, moral, and financial resources of the sect. Mr. Booth is already a printer and publisher, who, it is plainly declared, utilizes the officers of [260] the Army as agents for advertising and selling his publications; and some of them are so strongly impressed with the belief that active pushing of Mr. Booth's business is the best road to their master's favour, that when the public obstinately refuse to purchase his papers they buy them themselves and send the proceeds to headquarters. Mr. Booth is also a retail trader on a large scale, and the Dean of Wells has, most seasonably, drawn attention to the very notable banking project which he is trying to float. Any one who follows Dean Plumptre's clear exposition of the principles of this financial operation can have little doubt that, whether they are, or are not, adequate to the attainment of the first and second of Mr. Booth's ostensible objects, they may be trusted to effect a wide extension of any kingdom in which worldly possessions are of no value. We are, in fact, in sight of a financial catastrophe like that of Law a century ago. Only it is the poor who will suffer.

I have already occupied too much of your space, and yet I have drawn upon only one of the sources of information about the inner working of the Salvation Army at my disposition. Far graver charges than any here dealt with are publicly brought in the others.

I am, Sir, your obedient servant,
T. H. Huxley.

[261] P.S.–I have just read Mr. Buchanan's letter in the *Times* of to-day. Mr. Buchanan is, I believe, an imaginative writer. I am not acquainted with his works, but nothing in the way of fiction he has yet achieved can well surpass his account of my opinions and of the purport of my writings.

IV
The "Times" December 20*th,* 1890

Sir,–In discussing Mr. Booth's projects I have hitherto left in the background a distinction which must be kept well in sight by those who wish to form a fair judgment of the influence, for good or evil, of the Salvation Army. Salvationism, the work of "saving souls" by revivalist methods, is one thing; Boothism, the utilization of the workers for the furtherance of Mr. Booth's peculiar projects, is another. Mr. Booth has captured, and harnessed with sharp bits and effectual blinkers, a multitude of ultra-Evangelical missionaries of the revivalist school who were wandering at large. It is this skilfully, if somewhat mercilessly, driven team which has dragged the "General's" coach-load of projects into their present position.

[262] Looking, then, at the host of Salvationists proper, from the "captains" downwards (to whom, in my

judgment, the family hierarchy stands in the relation of the Old Man of the Sea to Sinbad), as an independent entity, I desire to say that the evidence before me, whether hostile or friendly to the General and his schemes, is distinctly favourable to them. It exhibits them as, in the main, poor, uninstructed, not unfrequently fanatical, enthusiasts, the purity of whose lives, the sincerity of whose belief, and the cheerfulness of whose endurance of privation and rough usage, in what they consider a just cause, command sincere respect. For my part, though I conceive the corybantic method of soul-saving to be full of dangers, and though the theological speculations of these good people are to me wholly unacceptable, yet I believe that the evils which must follow in the track of such errors, as of all other errors, will be largely outweighed by the moral and social improvement of the people whom they convert. I would no more raise my voice against them (so long as they abstain from annoying their neighbours) than I would quarrel with a man, vigorously sweeping out a stye, on account of the shape of his broom, or because he made a great noise over his work. I have always had a strong faith in the principle of the injunction, "Thou shalt not muzzle the ox that treadeth out the corn." If a kingdom is worth a Mass, as [263] a great ruler said, surely the reign of clean living, industry, and thrift is worth any quantity of tambourines and eccentric doctrinal hypotheses. All that I have hitherto said, and propose further to say, is directed against Mr. Booth's extremely clever, audacious, and hitherto successful attempt to utilize the credit won by all this honest devotion and self-sacrifice for the purposes of his socialistic autocracy.

I now propose to bring forward a little more evidence as to how things really stand where Mr. Booth's system has had a fair trial. I obtain it, mainly, from a curious pamphlet, the title of which runs: "The New Papacy. Behind the Scenes in the Salvation Army," by an ex-Staff Officer. "Make not my Father's house a house of merchandise" (John ii. 16). 1889. Published at Toronto, by A. Britnell. On the cover it is stated that "This is the book which was burned by the authorities of the Salvation Army." I remind the reader, once more, that the statements which I shall cite must be regarded as *ex parte;* all I can vouch for is that, on grounds of internal evidence and from other concurrent testimony respecting the ways of the Booth hierarchy, I feel justified in using them.

This is the picture the writer draws of the army in the early days of its invasion of the Dominion of Canada:–

[264] "Then, it will be remembered, it professed to be the humble handmaid of the existing churches; its professed object was the evangelization of the masses. It repudiated the idea of building up a separate religious body, and it denounced the practice of gathering together wealth and the accumulation of property. Men and women other than its own converts gathered around it and threw themselves heart and soul into the work, for the simple reason that it offered, as they supposed, a more extended and widely open field for evangelical effort. Ministers everywhere were invited and welcomed to its platforms, majors and colonels were few and far between, and the supremacy and power of the General were things unknown.... Care was taken to avoid anything like proselytism; its converts were never coerced into joining its ranks.... In a word, the organization occupied the position of an auxiliary mission and recruiting agency for the various religious bodies.... The meetings were crowded, people professed conversion by the score, the public liberally supplied the means to carry on the work in their respective communities; therefore every corps was wholly self-supporting, its officers were properly, if not luxuriously, cared for, the local expenditure was amply provided, and, under the supervision of the

secretary, a local member, and the officer in charge, the funds were disbursed in the towns where they [266] were collected, and the spirit of satisfaction and confidence was mutual all around" (pp. 4, 5).

Such was the army as the green tree. Now for the dry:–

"Those who have been daily conversant with the army's machinery are well aware how entirely and radically the whole system has changed, and how, from a band of devoted and disinterested workers, united in the bonds of zeal and charity for the good of their fellows, it has developed into a colossal and aggressive agency for the building up of a system and a sect, bound by rules and regulations altogether subversive of religious liberty and antagonistic to every (other?) branch of Christian endeavour, and bound hand and foot to the will of one supreme head and ruler.... As the work has spread through the country, and as the area of its endeavours has enlarged, each leading position has been filled, one after the other, by individuals strangers to the country, totally ignorant of the sentiments and idiosyncrasies of the Canadian people, trained in one school under the teachings and dominance of a member of the Booth family, and out of whom every idea has been crushed, except that of unquestioning obedience to the General, and the absolute necessity of going forward to his bidding without hesitation or question" (p. 6).

[266] "What is the result of all this? In the first place, whilst material prosperity has undoubtedly been attained, spirituality has been quenched, and, as an evangelical agency, the army has become almost a dead letter.... In seventy-five per cent. of its stations its officers suffer need and privation, chiefly on account of the heavy taxation that is placed upon them to maintain an imposing headquarters and a large ornamental staff. The whole financial arrangements are carried on by a system of inflation and a hand-to-mouth extravagance and blindness as to future contingencies. Nearly all of its original workers and members have disappeared" (p. 7). "In reference to the religious bodies at large the army has become entirely antagonistic. Soldiers are forbidden by its rules to attend other places of worship without the permission of their officers.... Officers or soldiers who may conscientiously leave the service or the ranks are looked upon and often denounced publicly as backsliders.... Means of the most despicable description have been resorted to in order to starve them back to the service" (p. 8). "In its inner workings the army system is identical with Jesuitism.... That 'the end justifies the means,' if not openly taught, is as tacitly agreed as in that celebrated order" (p. 9).

Surely a bitter, overcharged, anonymous libel, is the reflection which will occur to many who read [267] these passages, especially the last. Well, I turn to other evidence which, at any rate, is not anonymous. It is contained in a pamphlet entitled "General Booth, the Family, and the Salvation Army, showing its Rise, Progress, and Moral and Spiritual Decline," by S. H. Hodges, LL.B., late Major in the Army, and formerly private secretary to General Booth (Manchester, 1890). I recommend potential contributors to Mr. Booth's wealth to study this little work also. I have learned a great deal from it. Among other interesting novelties, it tells me that Mr. Booth has discovered "the necessity of a third step or blessing, in the work of Salvation. He said to me one day, 'Hodges, you have only two barrels to your gun; I have three'" (p. 31). And if Mr. Hodges's description of this third barrel is correct–"giving up your conscience" and, "for God and the army, stooping to do things which even honourable worldly men would not consent to do" (p. 32)–it is surely calculated to bring down a good many things, the first principles of morality among them.

Mr. Hodges gives some remarkable examples of the army practice with the "General's" new rifle. But I must refer the curious to his instructive pamphlet. The position I am about to take up is a serious one; and I prefer to fortify it by the help of evidence which, though some of it may be anonymous, cannot be sneered away. And I shall [268] be believed, when I say that nothing but a sense of the great social danger of the spread of Boothism could induce me to revive a scandal, even though it is barely entitled to the benefit of the Statute of Limitations.

On the 7th of July, 1883, you, Sir, did the public a great service by writing a leading article on the notorious "Eagle" case, from which I take the following extract:–

"Mr. Justice Kay refused the application, but he was induced to refuse it by means which, as Mr. Justice Stephen justly remarked, were highly discreditable to Mr. Booth. Mr. Booth filed an affidavit which appears totally to have misled Mr. Justice Kay, as it would have misled any one who regarded it as a frank and honest statement by a professed teacher of religion."

When I addressed my first letter to you I had never so much as heard of the "Eagle" scandal. But I am thankful that my perception of the inevitable tendency of all religious autocracies towards evil was clear enough to bring about a provisional condemnation of Mr. Booth's schemes in my mind. Supposing that I had decided the other way, with what sort of feeling should I have faced my friend, when I had to confess that the money had passed into the absolute control of a person about the character of whose administra[269]tion this concurrence of damnatory evidence was already extant?

I have nothing to say about Mr. Booth personally, for I know nothing. On that subject, as on several others, I profess myself an agnostic. But, if he is, as he may be, a saint actuated by the purest of motives, he is not the first saint who, as you have said, has shown himself "in the ardour of prosecuting a well-meant object" to be capable of overlooking "the plain maxims of every-day morality." If I were a Salvationist soldier, I should cry with Othello, "Cassio, I love thee; but never more be officer of mine."

I am, Sir, your obedient servant,
T. H. Huxley.

V

The "Times," December 24*th,* 1890

Sir,–If I have any strong points, finance is certainly not one of them. But the financial, or rather fiscal, operations of the General of the Salvation Army, as they are set forth and exemplified in "The New Papacy," possess that grand simplicity which is the mark of genius; [270] and even I can comprehend them–or, to be more modest, I can portray them in such a manner that every lineament, however harsh, and every shade, however dark, can be verified by published evidence.

Suppose there is a thriving, expanding colonial town, and that, scattered among its artisans and

labourers, there is a sprinkling of Methodists, or other such ultra-evangelical good people, doing their best, in a quiet way, to "save souls." Clearly, this is an outpost which it is desirable to capture. "We," therefore, take measures to get up a Salvation "boom" of the ordinary pattern. Enthusiasm is roused. A score or two of soldiers are enlisted into the ranks of the Salvation Army. "We" select the man who promises to serve our purposes best, make a "captain" of him, and put him in command of the "corps." He is very pleased and grateful; and indeed he ought to be. All he has done is that he has given up his trade; that he has promised to work at least nine hours a day in our service (none of your eight-hour nonsense for us) as collector, bookseller, general agent, and anything else we may order him to be. "We," on the other hand, guarantee him nothing whatever; to do so might weaken his faith and substitute worldly for spiritual ties between us. Knowing that, if he exerts himself in a right spirit, his labours will surely be blessed, we content ourselves with telling him that if, after all [271] expenses are paid and our demands are satisfied each week, 25*s.* remains, he may take it. And, if nothing remains, he may take that, and stay his stomach with what the faithful may give him. With a certain grim playfulness, we add that the value of these contributions will be reckoned as so much salary. So long as our "captain" is successful, therefore, a beneficent spring of cash trickles unseen into our treasury; when it begins to dry up we say, "God bless you, dear boy," turn him adrift (with or without 2*s.* 4*d.* in his pocket), and put some other willing horse in the shafts.

The "General," I believe, proposes, among other things, to do away with "sweating." May he not as well set a good example by beginning at home? My little sketch, however, looks so like a monstrous caricature that, after all, I must produce the original from the pages of my Canadian authority. He says that a "captain" "has to pay 10 per cent. of all collections and donations to the divisional fund for the support of his divisional officer, who has also the privilege of arranging for such special meetings as he shall think fit, the proceeds of which he takes away for the general needs of the division. Headquarters, too, has the right to hold such special meetings at the corps and send around such special attractions as its wisdom sees fit, and to take away the proceeds for the purposes it decides upon. [272] . . . He has to pay the rent of his building, either to headquarters or a private individual; he has to send the whole collection of the afternoon meeting of the first Sunday in the month to the 'Extension Fund' at headquarters; he has to pay for the heating, lighting, and cleaning of his hall, together with such necessary repairs as may be needed; he has to provide the food, lodging, and clothing of his cadet, if he has one; headquarters taxes him with so many copies of the army papers each week, for which he has to pay, sold or unsold; and when he has done this, he may take $6 (or $5, being a woman), or such proportion of it as may be left, with which to clothe and feed himself and to pay the rent and provide for the heating and lighting of his quarters. If he has a lieutenant he has to pay him $6 per week, or such proportion of it as he himself gets, and share the house expenses with him. Now, it will be easily understood that at least 60 per cent. of the stations in Canada the officer gets no money at all, and he has to beg specially amongst his people for his house-rent and food. There are few places in the Dominion in which the soldiers do not find their officers in all the food they need; but it must be remembered that the value of the food so received has to be accounted for at headquarters and entered upon the books of the corps as cash received, the amount being deducted from any moneys that the officer is able to take from the [273] week's collections. So that, no matter how much may be specially given, the officer cannot receive more than the value of $6 per week. The officer cannot collect any arrears of salary, as each week has to pay its own expenses; and if there is any surplus cash after all demands are met it must be

sent to the 'war chest' at headquarters."–"The New Papacy" (pp. 35, 36).

Evidently, Sir, "headquarters" has taken to heart the injunction about casting your bread upon the waters. It casts the crumb of a day or two's work of an emissary, and gets back any quantity of loaves of cash, so long as "captains" present themselves to be used up and replaced by new victims. What can be said of these devoted poor fellows except, *O sancta simplicitas*!

But it would be a great mistake to suppose that the money-gathering efficacy of Mr. Booth's fiscal agencies is exhausted by the foregoing enumeration of their regular operations. Consider the following edifying history of the "Rescue Home" in Toronto:–

"It is a fine building in the heart of the city; the lot cost $7,000, and a building was put up at a cost of $7,000 more, and there is a mortgage on it amounting to half the cost of the whole. The land to-day would probably fetch double its original price, and every year enhances its value .....In the first five months of its [274] existence this institution received from the public an income of $1,812 70c.; out of this $600 was paid to headquarters for rent, $590 52c. was spent upon the building in various ways, and the balance of $622 18c. paid the salaries of the staff and supported the inmates" (pp. 24, 25).

Said I not truly that Mr. Booth's fisc bears the stamp of genius? Who else could have got the public to buy him a "corner lot," put a building upon it, pay all its working expenses: and then, not content with paying him a heavy rent for the use of the handsome present they had made him, they say not a word against his mortgaging it to half its value? And, so far as any one knows, there is nothing to stop headquarters from selling the whole estate tomorrow, and using the money as the "General" may direct.

Once more listen to the author of "The New Papacy," who affirms that "out of the funds given by the Dominion for the evangelization of the people by means of the Salvation Army, one sixth had been spent in the extension of the Kingdom of God, and the other five sixths had been invested in valuable property, all handed over to Mr. Booth and his heirs and assigns, as we have already stated" (p. 26).

And this brings me to the last point upon which I wish to touch. The answer to all inquiries as to what has become of the enormous [275] personal and real estate which has been given over to Mr. Booth is that it is held "in trust." The supporters of Mr. Booth may feel justified in taking that statement "on trust." I do not. Anyhow, the more completely satisfactory this "trust" is, the less can any man who asks the public to put blind faith in his integrity and his wisdom object to acquaint them exactly with its provisions. Is the trust drawn up in favour of the Salvation Army? But what is the legal status of the Salvation Army? Have the soldiers any claim? Certainly not. Have the officers any legal interest in the "trust"? Surely not. The "General" has taken good care to insist on their renouncing all claims as a condition of their appointment. Thus, to all appearance, the army, as a legal person, is identical with Mr. Booth. And, in that case, any "trust" ostensibly for the benefit of the army is–what shall we say that is at once accurate and polite?

I conclude with these plain questions–Will Mr. Booth take counsel's opinion as to whether there is

anything in such legal arrangements as he has at present made which prevents him from disposing of the wealth he has accumulated at his own will and pleasure? Will anybody be in a position to set either the civil or the criminal law in motion against him or his successors if he or they choose to spend every farthing in ways [276] very different from those contemplated by the donors?

I may add that a careful study of the terms of a "Declaration of Trust by William Booth in favour of the Christian Mission," made in 1878, has not enabled persons of much greater competence than myself to answer these questions satisfactorily.[1]

I am, Sir, your obedient servant,
T. H. Huxley.

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[1] See p. 100.

On December 24th a letter appeared in the "Times" signed "J. S. Trotter," in which the following passages appear:–

"It seems a pity to put a damper on the spirits of those who agree with Professor Huxley in his denunciation of General Booth and all his works. May I give a few particulars as to the 'book' which was published in Canada? I had the pleasure of an interview with the author of a book written in Canada. The book was printed at Toronto, and two copies only struck off by the printers; one of these copies was stolen from the printer, and the quotation sent to you by Professor Huxley was inserted in the book, and is con[277]sequently a forgery. The book was published without the consent and against the will of the author.

"So the quotation is not only 'a bitter, overcharged anonymous libel,' as Professor Huxley intimates, but a forgery as well. As to Mr. Hodges, it seems to me to be simply trifling with your readers to bring him in as an authority. He was turned out of the army, out of kindness taken on again, and again dismissed. If this had happened to one of your staff, would his opinion of the 'Times' as a newspaper be taken for gospel?"

But in the "Times" of December 29th Mr. J. S. Trotter writes:–

"I find I was mistaken in saying, in my letter of Wednesday, to the 'Times' that Mr. Hodges was dismissed from the service of General Booth, and regret any inconvenience the statement may have caused to Mr. Hodges."

And on December 30th the "Times" published a letter from Mr. Hodges in which he says that Mr. Trotter's statements as they regard himself "are the very reverse of truth.–I was never turned out of the Salvation Army. Nor, so far as I was made acquainted with General Booth's motives, was I taken on again out of kindness. [278] In order to rejoin the Salvation Army, I resigned the position of manager in a mill where I was in receipt of a salary of £250 per annum, with house-rent and one third of the profits. Instead of this Mr. Booth allowed me £2 per week and house-rent.

VI

The "Times," December 26*th,* 1890

Sir,–I am much obliged to Mr. J. S. Trotter for the letter which you published this morning. It furnishes evidence, which I much desired to possess on the following points:–

1. The author of "The New Papacy" is a responsible, trustworthy person; otherwise Mr. Trotter would not speak of having had "the pleasure of an interview" with him.

2. After this responsible person had taken the trouble to write a pamphlet of sixty-four closely printed pages, some influence was brought to bear upon him, the effect of which was that he refused his consent to its publication. Mr. Trotter's excellent information will surely enable him to tell us what influence that was.

3. How does Mr. Trotter know that any passage [279] I have quoted is an interpolation? Does he possess that other copy of the "two" which alone, as he affirms, were printed?

4. If so, he will be able to say which of the passages I have cited is genuine and which is not; and whether the tenor of the whole uninterpolated copy differs in any important respect from that of the copy I have quoted.

It will be interesting to hear what Mr. J. S. Trotter has to say upon these points. But the really important thing which he has done is that he has testified, of his own knowledge, that the anonymous author of "The New Papacy" is no mere irresponsible libeller, but a person of whom even an ardent Salvationist has to speak with respect.

I am, Sir, your obedient servant,
T. H. Huxley.

[I may add that the unfortunate Mr. Trotter did me the further service of eliciting the letter from Mr. Hodges referred to on p. 277–which sufficiently establishes that gentleman's credit, and leads me to attach full weight to his evidence about the third barrel."]

January 1891.

VII
The "Times," December 27th, 1890

[280] SIR,–In making use of the only evidence of the actual working of Mr. Booth's autocratic government accessible to me, I was fully aware of the slippery nature of the ground upon which I was treading. For, as I pointed out in my first letter, "no personal habit more surely degrades the conscience and the intellect than blind and unhesitating obedience to unlimited authority." Now we have it, on Mr. Booth's own showing that every officer of his has undertaken to "obey without questioning or gainsaying the orders from headquarters." And the possible relations of such orders to honour and veracity are demonstrated not only by the judicial deliverance on Mr. Booth's affidavit in the "Eagle" case, which I have already cited; not only by Mr. Bramwell Booth's admission before Mr. Justice Lopes that he had stated what was "not quite correct" because he had "promised Mr. Stead not to divulge "the facts of the case (the "Times," November 4th, 1885); but by the following passage in Mr. Hodges's account of the reasons of his withdrawal from the Salvation Army:–

"The general and Chief did not and could not [281] deny doing these things; the only question was this, Was it right to practise this deception? These points of difference were fully discussed between myself and the Chief of the Staff on my withdrawal, especially the Leamington incident, which was the one that finally drove me to decision. I had come to the conclusion, from the first, that they had acted as they supposed with a single eye to the good of God's cause, and had persuaded myself that the things were, as against the devil, right to be done, that as in battle one party captured and turned the enemy's own guns upon them, so, as they were fighting against the devil, it would be fair to use against him his weapons. And I wrote to this effect to the General" (p. 63).

Now, I do not wish to say anything needlessly harsh, but I ask any prudent man these questions. Could I, under these circumstances, trust any uncorroborated statement emanating from headquarters, or made by the General's order? Had I any reason to doubt the truth of Mr. Hodges's naive confession of the corrupting influence of Mr. Booth's system? And did it not behove me to pick my way carefully through the mass of statements before me, many of them due to people whose moral sense might, by possibility, have been as much blunted by the army discipline in the [282] use of the weapons of the devil as Mr. Hodges affirms that his was?

Therefore, in my third letter, I commenced my illustrations of the practical working of Boothism with the evidence of Mr. Redstone, fortified and supplemented by that of a non-Salvationist, Dr. Cunningham Geikie. That testimony has not been challenged, and, until it is, I shall assume that it cannot be. In my fourth letter, I cited a definite statement by Mr. Hodges in evidence of the Jesuitical principles of headquarters. What sort of answer is it to tell us that Mr. Hodges was dismissed the army? A child might expect that some such red herring would be drawn across the trail; and, in anticipation of the stale trick, I added the strong *prima facie* evidence of the trustworthiness of my witness, in this particular, which is afforded by the "Eagle" case. It was not until I wrote my fourth letter to you, Sir–until the exploitation of the "captains" and the Jesuitry of headquarters could be proved up to the hilt–that I ventured to have recourse to "The New Papacy." So far as the pamphlet itself goes, this is an anonymous work; and, for

sufficient reasons, I did not choose to go beyond what was to be found between its covers. To any one accustomed to deal with the facts of evolution, the Boothism of "The New Papacy" was merely the natural and necessary development of the Boothism of Mr. Redstone's case and of the [283] "Eagle" case. Therefore, I felt fully justified in using it, at the same time carefully warning my readers that it must be taken with due caution.

Mr. Trotter's useful letter admits that such a book was written by a person with whom he had the "pleasure of an interview," and that a version of it (interpolated, according to his assertion) was published against the will of the author. Hence I am justified in believing that there is a foundation of truth in certain statements, some of which have long been in my possession, but which for lack of Mr. Trotter's valuable corroboration I have refrained from using. The time is come when I can set forth some of the heads of this information, with the request that Mr. Trotter, who knows all about the business, will be so good as to point out any error that there may be in them. I am bound to suppose that his sole object, like mine, is the elucidation of the truth, and to assume his willingness to help me therein to the best of his ability.

1. "The author of 'The New Papacy' is a Mr. Sumner, a person of perfect respectability, and greatly esteemed in Toronto, who held a high position in the Army. When he left, a large public meeting, presided over by a popular Methodist minister, passed a vote of sympathy with him."

[284] Is this true or false?

2. "On Saturday last, about noon, Mr. Sumner, the author of the book, and Mr. Fred Perry, the Salvation Army printer, accompanied by a lawyer, went down to Messrs. Imrie and Graham's establishment, and asked for all the manuscript, stereotype plates, &c., of the book. Mr. Sumner explained that the book had been sold to the Army, and, on a cheque for the amount due being given, the printing material was delivered up."

Did these paragraphs appear in the "Toronto Telegram" of April 24th, 1889, or did they not? Are the statements they contain true or false?

3. "Public interest in the fate or probable outcome of that mysterious book called 'The New Papacy; or, Behind the Scenes in the Salvation Army,' continues unabated, though the line of proceedings by the publisher and his solicitor, Mr. Smoke, of Watson, Thorne, Smoke, and Masten, has not been altered since yesterday. The book, no doubt, will be issued in some form. So far as known, only one complete copy remains, and the whereabouts of this is a secret which will be profoundly kept. It is safe to say that if the Commissioner kept on guessing until the next anniversary, he would not strike the secluded [285] location of the one volume among five thousand which escaped, when he and his assistant, Mr. Fred Perry, believed they had cast every vestige of the forbidden work into the fiery furnace. On Tuesday last, when the discovery was made that a copy of 'The New Papacy' was in existence, Publisher Britnell, of Yonge Street, was at once the suspected holder, and in a short time his book-store was the resort of army agents sent to reconnoitre" ("Toronto News," April 28th, 1889).

Is this a forgery, or is it not? Is it in substance true or false?

When Mr. Trotter has answered these inquiries categorically, we may proceed to discuss the question of interpolations in Mr. Sumner's book.

I am, Sir, your obedient servant,
T. H. Huxley.

[On the 26th of December a letter, signed J. T. Cunningham, late Fellow of University College, Oxford, called forth the following commentary.]

VIII
The "Times," December 29*th,* 1890

[286] Sir,–If Mr. Cunningham doubts the efficacy of the struggle for existence, as a factor in social conditions, he should find fault with Mr. Booth and not with me.

"I am labouring under no delusion as to the possibility of inaugurating the millennium by my social specific. In the struggle of life the weakest will go to the wall, and there are so many weak. The fittest in tooth and claw will survive. All that we can do is to soften the lot of the unfit, and make their suffering less horrible than it is at present" ("In Darkest England," p. 44).

That is what Mr. Cunningham would have found if he had read Mr. Booth's book with attention. And, if he will bestow equal pains on my second letter, he will discover that he has interpolated the word "wilfully" in his statement of my "argument," which runs thus: "Shutting his eyes to the necessary consequences of the struggle for life, the existence of which he admits as fully as any Darwinian, Mr. Booth tells men whose evil case is one of those consequences that envy is a corner-stone of our competitive system." [287] Mr. Cunningham's physiological studies will have informed him that the process of "shutting the eyes," in the literal sense of the words, is not always wilful; and I propose to illustrate, by the crucial instance his own letter furnishes, that the "shutting of the eyes" of the mind to the obvious consequences of accepted propositions may also be involuntary. At least, I hope so.

1. "Sooner or later," says Mr. Cunningham, "the population problem will block the way once more." What does this mean, except that multiplication, excessive in relation to the contemporaneous means of support, will create a severe competition for those means? And this seems to me to be a pretty accurate "reflection of the conceptions of Malthus" and the other poor benighted folks of a past generation at whom Mr. Cunningham sneers.

2. By way of leaving no doubt upon this subject, Mr. Cunningham further tells us, "The struggle for existence is always going on, of course; let us thank Darwin for making us realize it." It is pleasant to meet with a little gratitude to Darwin among the *epigoni* who are squabbling over the heritage he

conquered for them, but Mr. Cunningham's personal expression of that feeling is hasty. For it is obvious that he has not "realized" the significance of Darwin's teaching–indeed, I fail to discover in Mr. Cunningham's letter any sign that he has even "realized" what [288] he would be at. If the "struggle for existence is always going on"; and if, as I suppose will be granted, industrial competition is one phase of that struggle, I fail to see how my conclusion that it is sheer wickedness to tell ignorant men that "envy" is a corner-stone of competition can be disputed.

Mr. Cunningham has followed the lead of that polished and instructed person, Mr. Ben Tillett, in rebuking me for (as the associates say) attacking Mr. Booth's personal character. Of course, when I was writing, I did not doubt that this very handy, though not too clean, weapon would be used by one or other of Mr. Booth's supporters. And my action was finally decided by the following considerations: I happen to be a member of one of the largest life insurance societies. There is a vacancy in the directory at present, for which half a dozen gentlemen are candidates. Now, I said to myself, supposing that one of these gentlemen (whose pardon I humbly beg for starting the hypothesis), say Mr. A., in his administrative capacity and as a man of business, has been the subject of such observations as a Judge on the Bench bestowed upon Mr. Booth, is he a person for whom I can properly vote? And, if I find, when I go to the meeting of the policy-holders, that most of them know nothing of this and other evidences of what, by the mildest judgment, must be termed Mr. A.'s unfitness for administrative [289] responsibilities, am I to let them remain in their ignorance? I leave the answer and its application to men of sense and integrity.

The mention of Mr. Cunningham's ally reminds me that I have omitted to thank Mr. Tillett for his very useful and instructive letter; and I hasten to repair a neglect which I assure Mr. Tillett was more apparent than real. Mr. Tillett's letter is dated December 20th. On the 21st the following pregnant (however unconscious) commentary upon it appeared in "Reynolds's Newspaper":–

"I have always maintained that the Salvation Army is one of the mightiest Socialistic agencies in the country; and now Professor Huxley comes in to confirm that view. How could it be otherwise? The fantastic religious side of Salvationism will disappear in the course of time, and what will be left? A large number of men and women who have been organized, disciplined, and taught to look for something better than their present condition, and who have become public speakers and not afraid of ridicule. There you have the raw materials for a Socialist army."

Mr. Ben Tillett evidently knows Latin enough to construe *proximus ardet.*

I trust that the public will not allow themselves to be led away by the false issues which are [290] dangled before them. A man really may love his fellow-men; cherish any form of Christianity he pleases; and hold not only that Darwinism is "tottering to its fall," but, if he pleases, the equally sane belief that it never existed; and yet may feel it his duty to oppose, to the best of his capacity, despotic Socialism in all its forms, and, more particularly, in its Boothian disguise.

I am, Sir, your obedient servant,

[Persons who have not had the advantage of a classical education might fairly complain of my use of the word *epigoni.* To say truth, I had been reading Droysen's "Geschichte des Hellenismus," and the familiar historical title slipped out unawares. In replying to me, however, the late "Fellow of University College," Oxford, declares he had to look the word out in a Lexicon. I commend the fact to the notice of the combatants over the desirability of retaining the present compulsory modicum of Greek in our Universities.]

IX

The "Times," December 30*th,* 1890

[291] Sir,–I am much obliged to Messrs. Ranger, Burton, and Matthews for their prompt answer to my questions. I presume it applies to all money collected by the agency of the Salvation Army, though not specifically given for the purposes of the "Christian Mission" named in the deed of 1878; to all sums raised by mortgage upon houses and land so given; and, further, to funds subscribed for Mr. Booth's various projects, which have no apparent reference to the objects of the "Christian Mission" as defined in the deed. Otherwise, to use a phrase which has become classical, "it does not assist us much." But I must leave these points to persons learned in the law.

And, indeed, with many thanks to you, Sir, for the amount of valuable space which you have allowed me to occupy, I now propose to leave the whole subject. My sole purpose in embarking upon an enterprise which was extremely distasteful to me was to prevent the skilful "General," or rather "Generals," who devised the plan of campaign from sweeping all before them with a rush. I found the pass already held by such stout defenders as Mr. Loch and the [292] Dean of Wells, and, with your powerful help, we have given time for the reinforcements, sure to be sent by the abundant, though somewhat slowly acting, common sense of our countrymen, to come up.

I can no longer be useful, and I return to more congenial occupations.

I am, Sir, your obedient servant,
T. H. Huxley.

The following letter appeared in the "Times" of January 2nd, 1891:–

"Dear Mr. Tillett,–I have not had patience to read Professor Huxley's letters. The existence of hunger, nakedness, misery, 'death from insufficient food,' even of starvation, is certain, and no agency as yet reaches it. How can any man hinder or discourage the giving of food or help? Why is the house called a workhouse? Because it is for those who cannot work? No, because it was the house to give work or bread. The very name is an argument. I am very sure what Our Lord and His Apostles would do if they were in London. Let us be thankful even to have a will to do the same.

"Yours faithfully,
Henry E. Card. Manning."

X

The "Times," January 3*rd*, 1891

[293] Sir,–In my old favourite, "The Arabian Nights," the motive of the whole series of delightful narratives is that the sultan, who refuses to attend to reason, can be got to listen to a story. May I try whether Cardinal Manning is to be reached in the same way? When I was attending the meeting of the British Association in Belfast nearly forty years ago, I had promised to breakfast with the eminent scholar Dr. Hincks. Having been up very late the previous night, I was behind time; so, hailing an outside car, I said to the driver as I jumped on, "Now drive fast, I am in a hurry." Whereupon he whipped up his horse and set off at a hand-gallop. Nearly jerked off my seat, I shouted, "My good friend, do you know where I want to go?" "No, yer honner," said the driver, "but, any way, I am driving fast." I have never forgotten this object-lesson in the dangers of ill-regulated enthusiasm. We are all invited to jump on to the Salvation Army car, which Mr. Booth is undoubtedly driving very fast. Some of us have a firm conviction, not only that he is taking a very different direction from that in which we wish to go, but that, before long, car and driver will come to grief. Are we to accept [294] the invitation, even at the bidding of the eminent person who appears to think himself entitled to pledge the credit of "Our Lord and His Apostles" in favour of Boothism?

I am, Sir, your obedient servant,
T. H. Huxley.

XI

The "Times," January 13*th*, 1891

Sir,–A letter from Mr. Booth-Clibborn, dated January 3rd, appeared in the "Times" of yesterday. This elaborate document occupies three columns of small print–space enough, assuredly, for an effectual reply to the seven letters of mine to which the writer refers, if any such were forthcoming. Mr. Booth-Clibborn signs himself "Commissioner of the Salvation Army for France and Switzerland," but he says that he accepts my "challenge" without the knowledge of his chiefs. Considering the self-damaging character of his letter, it was, perhaps, hardly necessary to make that statement.

Mr. "Commissioner" Booth-Clibborn speaks of my "challenge." I presume that he refers to my [295] request for information about the authorship and fate of "The New Papacy," in the letter published in the "Times" on December 27th, 1890. The "Commissioner" deals with this matter in paragraph No. 4 of his letter; and I observe, with no little satisfaction, that he does not venture to controvert any one of the statements of my witnesses. He tacitly admits that the author of "The New Papacy" was a person "greatly esteemed in Toronto," and that he held "a high position in the army"; further, that the Canadian "Commissioner" thought it worth while to pay the printer's bill, in order that the copies already printed off might be destroyed and the pamphlet effectually suppressed. Thus the essential facts of the case are

admitted and established beyond question.

How does Mr. Booth-Clibborn try to explain them away?

"Mr. Sumner, who wrote the little book in a hot fit, soon regretted it (as any man would do whose conscience showed him in a calmer moment when his 'respectability' returned with his repentance, that he had grossly misrepresented), and just before it appeared offered to order its suppression if the army would pay the costs already incurred, and which he was unable to bear."

"The New Papacy" fills sixty closely printed duodecimo pages. It is carefully written, and for the most part in studiously moderate language; [296] moreover, it contains many precise details and figures, the ascertainment of which must have taken much time and trouble. Yet, forsooth, it was written in "a hot fit."

I sincerely hope, for the sake of his own credit, that Mr. "Commissioner" Booth-Clibborn does not know as much about this melancholy business as I do. My hands are unfortunately tied, and I am not at liberty to use all the information in my possession. I must content myself with quoting the following passage from the preface to "The New Papacy":–

"It has not been without considerable thought and a good deal of urging that the following pages have been given to the public. But though we would have shrunk from a labour so distasteful, and have gladly avoided a notoriety anything but pleasant to the feelings, or conducive to our material welfare, we have felt that in the interests of the benevolent public, in the interests of religion, in the interests of a band of devoted men and women whose personal ends are being defeated, and the fruit of whose labour is being destroyed, and, above all, in the interests of that future which lies before the Salvation Army itself, if purged and purified in its executive and returned to its original position in the ranks of Canadian Christian effort, it is no more than our duty to throw such light as we are able upon its true inwardness, and with that [297] object and for the furtherance of those ends we offer our pages to the public view."

The preface is dated April 1889. According to the statement in the "Toronto Telegram" which Mr. "Commissioner" Booth-Clibborn does not dare to dispute, his Canadian fellow-"Commissioner" bought and destroyed the whole edition of "The New Papacy" about the end of the third week in April. It is clear that the writer of the paragraph quoted from the preface was well out of a "hot fit," if he had ever been in one, while he had not entered on the stage of repentance within three weeks of that time. Mr. "Commissioner" Booth-Clibborn's scandalous insinuations that Mr. Sumner was bribed by "a few sovereigns," and that he was "bought off," in the face of his own admission that Mr. Sumner "offered to order its suppression if the army would pay the costs already incurred, and which he was unable to bear" is a crucial example of that Jesuitry with which the officials of the army have been so frequently charged.

Mr. "Commissioner" Booth-Clibborn says that when "London headquarters heard of the affair, it disapproved of the action of the Commissioner." That circumstance indicates that headquarters is not wholly devoid of intelligence; but it has nothing to do with the value of Mr. Sumner's evidence, which is

all I am concerned about. Very likely London headquarters will disapprove [298] of its French "Commissioner's" present action. But what then? The upshot of all this is that Mr. Booth-Clibborn has made as great a blunder as simple Mr. Trotter did. The pair of Balaams greatly desired to curse, but have been compelled to bless. They have, between them, completely justified my reliance on Mr. Sumner as a perfectly trustworthy witness; and neither of them has dared to challenge the accuracy of one solitary statement made by that worthy gentleman, whose full story I hope some day or other to see set before the public. Then the true causes of his action will be made known.

Paragraph 2 of the "Commissioner's" letter says many things, but not much about Mr. Hodges. The columns of the "Times" recently showed that Mr. Hodges was able to compel an apology from Mr. Trotter. I leave it to him to deal with the "Commissioner."

As to the "Eagle" case, treated of in paragraph No. 3, a gentleman well versed in the law, who was in court during the hearing of the appeal, has assured me that the argument was purely technical; that the facts were very slightly gone into; and that, so far as he knows, no dissenting comment was made on the strictures of the Judge before whom the case first came. Moreover, in the judgment of the Master of the Rolls, fully recorded in the "Times" of February 14th, 1884, the following passages occur:–

[299] "The case had been heard by a learned Judge, who had exercised his discretion upon it, and the Court would not interfere with his discretion unless they could see that he was wrong. The learned Judge had taken a strong view of the conduct of the defendant, but nevertheless had said that he would have given relief if he could have seen how far protection and compensation could be given. And if this Court differed from him in that view, and could give relief without forfeiture, they would be acting on his own principle in doing so. Certain suggestions had been made with that view, and the Court had to consider the case under all the circumstances.... He himself (the Master of the Rolls) considered that it was probable the defendant, with his principles, had intended to destroy the property as a public-house, and that it was not right thus to take property under a covenant to keep it up as a public-house, intending to destroy it as such. He did not, however, think this was enough to deprive him of all relief . . . The defendant could only expect severe terms."

Yet, Sir, Mr. "Commissioner" Booth-Clibborn, this high official of the Salvation Army, has the audacity to tell the public that if I had made inquiries I should have found that "in the Court of Appeal the Judge reversed the decision of his predecessor as regards seven eighths of the property, and the General was declared to have acted [300] all along with straight-forwardness and good faith."

But the nature of Mr. "Commissioner" Booth-Clibborn's conceptions of straightforwardness and good faith is so marvellously illustrated by the portions of his letter with which I have dealt that I doubt not his statements are quite up to the level of the "Army" Regulations and Instructions in regard to those cardinal virtues. As I pointed out must be the case, the slave is subdued to that he works in.

For myself, I must confess that the process of wading through Mr. "Commissioner's" verbose and clumsy pleadings has given me a "hot fit," which, I undertake to say, will be followed by not so much as

a passing shiver of repentance. And it is under the influence of the genial warmth diffused through the frame, on one of those rare occasions when one may be "angry and sin not," that I infringe my resolution to trouble you with no more letters. On reflection, I am convinced that it is undesirable that the public should be misled, for even a few days, by misrepresentations so serious.

I am copiously abused for speaking of the Jesuitical methods of the superior officials of the Salvation Army. But the following facts have not been, and, I believe, cannot be, denied:–

1. Mr. Booth's conduct in the "Eagle" case has been censured by two of the Judges.

[301] 2. Mr. Bramwell Booth admitted before Mr. Justice Lopes that he had made an untrue statement because of a promise he had made to Mr. Stead.[1]

And I have just proved that Mr. "Commissioner" Booth-Clibborn asserts the exact contrary of that which your report of the judgment of the Master of the Rolls tells us that distinguished judge said.

Under these circumstances, I think that my politeness in applying no harder adjective than "Jesuitical" to these proceedings is not properly appreciated.

I am, Sir, your obedient servant,
T. H. Huxley.

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[1] This statement has been disputed, but not yet publicly. (See p. 305.)

XII
The "Times," January 22*nd*, 1891

SIR,–I think that your readers will be interested in the accompanying opinion, written in consultation with an eminent Chancery Queen's Counsel, with which I have been favoured. It will be observed that this important legal de[302]liverance justifies much stronger language than any which I have applied to the only security (?) for the proper administration of the funds in Mr. Booties hands which appears to be in existence.

I am, Sir, your obedient servant,
T. H. Huxley.

1. Dr. Johnson's Buildings, Temple, E.C.,

January 14, 1891.

MR. BOOTH'S DECLARATION OF TRUST DEED, 1878.

"I am of opinion, subject to the question whether there may be any provision in the Charitable Trusts Acts which can be made available for enforcing some scheme for the appropriation of the property, and with regard to the real and leasehold properties whether the conveyances and leases are not altogether void, as frauds on the Mortmain Acts, that nothing can be done to control or to interfere with Booth in the disposition or application of the properties or moneys purported to be affected by the deed.

"As to the properties vested in Booth himself, it appears to me that such are placed absolutely under his power and control both as to the disposal and application thereof, and that there are no trusts for any specific purposes declared which [303] could be enforced, and that there are no defined persons nor classes of persons who can claim to be entitled to the benefit of them, or at whose instance they could be enforced by any legal process.

"As to the properties (if any) vested in trustees appointed by Booth, it appears to me that the only person who has a *locus standi* to enforce these trusts is Booth himself, and that he would have absolute power over the trusts and the property, and might deal with the property as he pleased, and that, as in the former case, nothing could be done in the way of enforcing any trusts against him.

"As to the moneys contributed or raised by mortgage for the general purposes of the mission, it appears to me that Booth may expend them as he pleases, without being subject to any legal control, and that he cannot even be compelled to publish any balance-sheets.

"Whether there are any provisions in the Charitable Trusts Acts which could be made available for enforcing some scheme for the application of the property or funds is a question to which I should require to give a closer consideration should it become necessary to go into it; but at present, after perusing these Acts, and especially 16 and 17 Vict. c. 137 and 18 and 19 Vict. c. 124, I cannot see how they could be made applicable to the trusts as declared in this deed.

[304] "As to the Mortmain Acts, the matter is clearly charitable, and unless in the conveyances and leases to Booth, or to the trustees (if any) named by him, all the provisions of the Acts have been complied with, and the deeds have been enrolled under the Acts, they would be void. It is probable, however, that every conveyance and lease has been taken without disclosing any charitable trust, for the purpose of preventing it from being void on the face of it. It is to be noted that the deed is a mere deed poll by Booth himself, without any other party to it, who, as a contracting party, would have a right to enforce it.

"Whether there are any objects of the trust I cannot say. If there is, as the recital indicates, a society of enrolled members called 'The Christian Mission,' those members would be objects of the trust, but then,

it appears to me, Booth has entire control and determination of the application. And, as to the trusts enuring for the benefit of the 'Salvation Army,' I am not aware what is the constitution of the 'Salvation Army,' but there is no reference whatever to any such body in the deed. I have understood the army as being merely the missionaries, and not the society of worshippers.

"If there is no Christian Mission Society of enrolled members, then there are no objects of the trust. The trusts are purely religious, and trading is entirely beyond its purposes. Booth can 'give [305] away' the property, simply because there is no one who has any right to prevent his doing so.

"Ernest Hatton."

It is probably my want of legal knowledge which prevents me from appreciating the value of the professed corrections of Mr. Hatton's opinion contained in the letters of Messrs. Ranger, Burton, and Matthews, "Times," January 28th and 29th, 1891.

The note on page 301 refers to a correspondence, incomplete at the time fixed for the publication of my pamphlet, the nature of which is sufficiently indicated by the subjoined extracts from Mr. Stead's letter in the "Times of January 20th, and from my reply in the "Times" of January 24th. Referring to the paragraphs numbered 1, 2, at the end of my letter XI., Mr. Stead says:–

"On reading this, I at once wrote to Professor Huxley, stating that, as he had mentioned my name, I was justified in intervening to explain that, so far as the second count in his indictment went–for the Eagle dispute is no concern of mine–he had been misled by an error in the reports of the case which appeared in the daily [306] papers of November 4, 1885. I have his reply to-day, saying that I had better write to you direct. May I ask you, then, seeing that my name has been brought into the affair, to state that, as I was in the dock when Mr. Bramwell Booth was in the witness-box, I am in a position to give the most unqualified denial to the statement as to the alleged admission on his part of falsehood? Nothing was heard in Court of any such admission. Neither the prosecuting counsel nor the Judge who tried the case ever referred to it, although it would obviously have had a direct bearing on the credit of the witness; and the jury, by acquitting Mr. Bramwell Booth, showed that they believed him to be a witness of truth. But fortunately the facts can be verified beyond all gainsaying by a reference to the official shorthand-writer's report of the evidence. During the hearing of the case for the prosecution, Inspector Borner was interrupted by the Judge, who said:–

"'I want to ask you a question. During the whole of that conversation, did Booth in any way suggest that that child had been sold?' Borner replied:–

"'Not at that interview, my Lord.'

"It was to this that Mr. Bramwell Booth referred when, after examination, cross-examina[307]tion, and re-examination, during which no suggestion had been made that he had ever made the untrue statement now alleged against him, he asked and received leave from the Judge to make the following explanation,

which I quote from the official report:–

"'Will you allow me to explain a matter mentioned yesterday in reference to a question asked by your Lordship some days ago with respect to one matter connected with my conduct? Your Lordship asked, I think it was Inspector Borner, whether I had said to him at either of our interviews that the child was sold by her parents, and he replied "No." That is quite correct; I did not say so to him, and what I wish to say now is that I had been specially requested by Mr. Stead, and had given him a promise, that I would not under any circumstances divulge the fact of that sale to any person which would make it at all probable that any trouble would be brought upon the persons who had taken part in this investigation.' (Central Criminal Court Reports, Vol. CII., part 612, pp. 1,035-6.)

"In the daily papers of the following day this statement was misreported as follows:–

"'I wish to explain, in regard to your Lordship's condemnation of my having said "No" to [308] Inspector Borner when he asked me whether the child had been sold by her parents–the reason why I stated what was not correct was that I had promised Mr. Stead not to divulge the fact of the sale to any person which would make it probable that any trouble should be brought on persons taking part in this proceeding.'

"Hence the mistake into which Professor Huxley has unwittingly fallen.

"I may add that, so far from the statement never having been challenged for five years, it was denounced as 'a remarkably striking lie' in the 'War Cry' of November 14th, and again the same official organ of the Salvation Army of November 18th specifically adduced this misreport as an instance of 'the most disgraceful way' in which the reports of the trial were garbled by some of the papers. What, then, becomes of one of the two main pillars of Professor Huxley's argument?"

In my reply, I point out that, on the 10th of January, Mr. Stead addressed to me a letter, which commences thus: "I see in the 'Times' of this morning that you are about to republish your letters on Booth's book."

I replied to this letter on the 12th of January:–

[309] "Dear Mr. Stead,–I charge Mr. Bramwell Booth with nothing. I simply quote the 'Times' report, the accuracy of which, so far as I know, has never been challenged by Mr. Booth. I say I quote the 'Times' and not Mr. Hodges[1], because I took some pains about the verification of Mr. Hodges's citation.

"I should have thought it rather appertained to Mr. Bramwell Booth to contradict a statement which refers, not to what you heard, but to what he said. However, I am the last person to wish to give circulation to a story which may not be quite correct; and I will take care, if you have no objection (your letter is marked 'private'), to make public as much of your letter as relates to the point to which you have called my attention.

"I am, yours very faithfully,
T. H. Huxley."

---

[1] This is a slip of the pen. Mr. Hodges had nothing to do with the citation of which I made use.

To this Mr. Stead answered, under date of January 13th, 1891:–

"Dear Professor Huxley,–I thank you for your letter of the 12th inst. I am quite sure you would not wish to do any injustice in this matter. But, instead of publishing any extract from my letter, might I ask you to read the passage as it [310] appears in the verbatim report of the trial which was printed day by day, and used by counsel on both sides, and by the Judge during the case? I had hoped to have got you a copy to-day, but find that I was too late. I shall have it first thing to-morrow morning. You will find that it is quite clear, and conclusively disposes of the alleged admission of untruthfulness. Again thanking you for your courtesy,

"I am, yours faithfully,
W. T. Stead."

Thus it appears that the letter which Mr. Stead wrote to me on the 13th of January does not contain one word of that which he ways it contains, in the statement which appears in the "Times" to-day. Moreover, the letter of mine to which Mr. Stead refers in his first communication to me is not the letter which appeared on the 13th, as he states, but that which you published on December 27th, 1890. Therefore, it is not true that Mr. Stead wrote "at once." On the contrary, he allowed nearly a fortnight to elapse before he addressed me on the 10th of January 1891. Furthermore, Mr. Stead suppresses the fact that, since the 13th of January, he has had in his possession my offer to publish his version of the story; and he leads the reader to suppose that my only answer was that he "had better write to [311] you direct." All the while, Mr. Stead knows perfectly well that I was withheld from making public use of his letter of the 10th by nothing but my scruples about using a document which was marked "private"; and that he did not give me leave to quote his letter of the 10th of January until after he had written that which appeared yesterday.

And I add:–

As to the subject-matter of Mr. Stead's letter, the point which he wishes to prove appears to be this–that Mr. Bramwell Booth did not make a false statement, but that he withheld from the officers of justice, pursuing a most serious criminal inquiry, a fact of grave importance, which lay within his own knowledge. And this because he had promised Mr. Stead to keep the fact secret. In short, Mr. Bramwell Booth did not say what was wrong; but he did what was wrong.

I will take care to give every weight to the correction. Most people, I think, will consider that one of the "main pillars of my argument," as Mr. Stead is pleased to call them, has become very much strengthened.

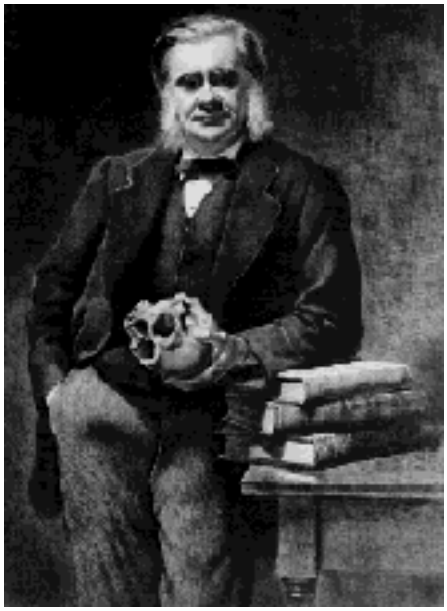
THE HUXLEY FILE

Preface and Table of Contents to Volume IX, *Evolution & Ethics and Other Essays*, of Huxley's *Collected Essays.*

Next part of this article, Social Diseases and Worse Remidies: Legal Opinions, pages 312-320.

Previous part of this article: The Struggle for Existence in Human Society, pages 195-236.

C. Blinderman & D. Joyce
Clark University



Darkest England Scheme (1890)

Collected Essays IX

LEGAL OPINIONS RESPECTING "GENERAL" BOOTH'S ACTS.

[312] In referring to the course of action adopted by "General" Booth and Mr. Bramwell Booth in respect of their legal obligations to other persons, or to the criminal and civil law, I have been as careful as I was bound to be, to put any difficulties suggested by mere lay commonsense in an interrogative or merely doubtful form; and to confine myself, for any positive expressions, to citations from published declarations of the judges before whom the acts of "General" Booth came; from reports of the Law Courts; and from the deliberate opinions of legal experts. I have now some further remarks to make on these topics.

I. The observations at p. 305 express, with due reserve, the impression which the counsel's opinions, quoted by "General" Booth's solicitors, made on my mind. They were written and sent to the printer before I saw the letter from a "Barrister *not* Practising on the Common Law Side," and those from Messrs. Clarke and Calkin and Mr. George Kebbell, which appeared in the "Times" of February 3rd and 4th.

These letters fully bear out the conclusion which I had formed, but which it would have [313] been presumptuous on my part to express, that the opinions cited by "General" Booth's solicitors were like the famous broken tea-cups "wisely ranged for show"; and that, as Messrs. Clarke and Calkin say, they "do not at all meet the main points on which Mr. Hatton advised." I do not think that any one who reads attentively the able letter of "A Barrister *not* Practicing on the Common Law Side" will arrive at any other conclusion; or who will not share the very natural desire of Mr. Kebbell to be provided with clear and intelligible answers to the following inquiries:–

(1) Does the trust deed by its operation empower any one legally to call upon Mr. Booth to account for the application of the funds?

(2) In the event of the funds not being properly accounted for, is any one, and, if so, who, in a position to institute civil or criminal proceedings against any one, and whom, in respect of such refusal or neglect to account?

(3) In the event of the proceedings, civil or criminal, failing to obtain restitution of misapplied funds, is or are any other person or persons liable to make good the loss?

On December 24th, 1890, a letter of mine appeared in the "Times" (No. V. above) in which I put questions of the same import, and asked Mr. Booth if he would not be so good as to take counsel's opinion on the "trusts" of which so [314] much has been heard and so little seen, not as they stood in

1878, or in 1888, but as they stand now? Six weeks have elapsed, and I wait for a reply.

It is true that Dr. Greenwood has been authorized by Mr. Booth to publish what he calls a "Rough outline of the intended Trust Deed" ("General Booth and His Critics," p. 120), but unfortunately we are especially told that it "*does not profess to be an absolutely accurate analysis.*" Under these circumstances I am afraid that neither lawyers nor laymen of moderate intelligence will pay much attention to the assertion, that "*it gives a fair idea of the general effect of the draft,*" even although "*the words in quotation marks are taken from it verbatim.*"

These words, which I give in italics, (1) define the purposes of the scheme to be *"for the social and moral regeneration and improvement of persons needy, destitute, degraded, or criminal, in some manner indicated, implied, or suggested in the book called 'In Darkest England.*" Whence I apprehend that, if the whole funds collected are applied to "mothering society" by the help of speculative attorney "tribunes of the people," the purposes of the trust will be unassailably fulfilled. (2) The name is to be "*Darkest England Scheme,*" (3) the General of the Salvation Army is to be *"Director of the Scheme.*" Truly valuable information all this! But taking it for what it is worth, [315] the public must not be misled into supposing that it has the least bearing upon the questions to which neither I, nor anybody else, has yet been able to obtain an intelligible answer, and that is, where are the vast funds which have been obtained, in one way or another, during the last dozen years in the name of the Salvation Army? Where is the presumably amended Trust Deed of 1888? I ask once more: Will Mr. Booth submit to competent and impartial legal scrutiny the arrangements by which he and his successors are prevented from dealing with the funds of the so-called "army chest" exactly as he or they may please?

II. With respect to the "Eagle" case, I am advised that Dr. Greenwood, whose good faith I do not question, has been misled into misrepresenting it in the appendix to his pamphlet. And certainly, the evidence of authoritative records which I have had the opportunity of perusing, appears to my non-legal mind to be utterly at variance with the statement to which Dr. Greenwood stands committed. I may observe, further, that the excuse alleged on behalf of Mr. Booth, that he signed the affidavit set before him by his solicitors without duly considering its contents, is one which I should not like to have put forward were the case my own. It may be, and often is, necessary for a person to sign an affidavit without [316] being able fully to appreciate the technical language in which it is couched. But his solicitor will always instruct him as to the effect of these terms. And, in this particular case where the whole matter turns on Mr. Booth's personal intentions, it was his plainest duty to inquire, very seriously, whether the legal phraseology employed would convey neither more nor less than such intentions to those who would act on the affidavit, before he put his name to it.

III. With respect to Mr. Bramwell Booth's case, I refer the reader to p. 311.

IV. As to Mr. Booth-Clibborn's misrepresentations, see above, pp. 298, 299.

This much for the legal questions which have been raised by various persons since the first edition of the pamphlet was published.

DR. GREENWOOD'S "GENERAL BOOTH AND HIS CRITICS"

So far as I am concerned, there is little or nothing in this *brochure* beyond a reproduction of the vituperative stuff which has been going the round of those newspapers which favour "General" Booth for some weeks. Those who do not want to see the real worth of it all will not read the [317] preceding pages; and those who do will need no help from me.

I fear, however, that in justice to other people I must put one of Dr. Greenwood's paragraphs in the pillory. He says that I have "built up, on the flimsy foundation of stories told by three or four deserters from the Army" (p. 114), a sweeping indictment against General Booth. This is the sort of thing to which I am well accustomed at the hands of anonymous newspaper writers. But in view of the following easily verifiable statements, I do not think that an educated and, I have no doubt, highly respectable gentleman like Dr. Greenwood can, in cold blood, contemplate that assertion with satisfaction.

The persons here alluded to as "three or four deserters from the army" are:–

(1) Mr. Redstone, for whose character Dr. Cunningham Geikie is guarantee, and whom it has been left to Dr. Greenwood to attempt to besmirch.

(2) Mr. Sumner, who is a gentleman quite as worthy of respect as Dr. Greenwood, and whose published evidence not one of the champions of the Salvation Army has yet ventured to impugn.

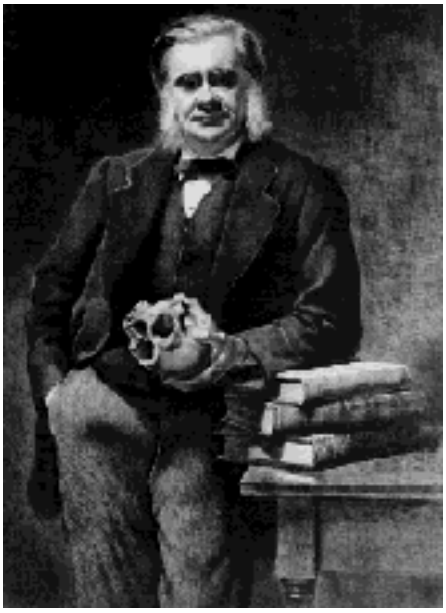
(3) Mr. Hodges, similarly libelled by that unhappy meddler Mr. Trotter, who was compelled to the prompt confession of his error (see p. 277).

(4) Notwithstanding this evidence of Mr. Trotter's claims to attention, Dr. Greenwood quotes a statement of his as evidence that a statement quoted by me from Mr. Sumner's work is a "forgery." But Dr. Greenwood [318] unfortunately forgets to mention that on the 27th of December 1890 (Letter No. VII. above) Mr. Trotter was publicly required to produce proof of his assertion; and that he has not thought fit to produce that proof.

If I were disposed to use to Dr. Greenwood language of the sort he so freely employs to me, I think that he could not complain of a handsome scolding. For what is the real state of the case? Simply this–that having come to the conclusion, from the perusal of "In Darkest England," that "General" Booth's colossal scheme (as apart from the local action of Salvationists) was bad in principle and must produce certain evil consequences, and having warned the public to that effect, I quite unexpectedly found my hands full of evidence that the exact evils predicted had, in fact, already shown themselves on a great scale; and, carefully warning the public to criticize this evidence, I produced a small part of it. When Dr. Greenwood talks about my want of "regard to the opinion of the nine thousand odd who still remain among the faithful" (p. 114), he commits an imprudence. He would obviously be surprised to learn the extent of the support, encouragement, and information which I have received from active and sincere members of the Salvation [319] Army–but of which I can make no use, because of the terroristic

discipline and systematic espionage which my correspondents tell me is enforced by its chief. Some of these days, when nobody can be damaged by their use, a curious light may be thrown upon the inner workings of the organization which we are bidden to regard as a happy family, by these documents.

C. Blinderman & D. Joyce
Clark University



Darkest England Scheme (1890)

Collected Essays IX

THE SALVATION ARMY ARTICLES OF WAR

[321] To be signed by all who wish to be entered on the roll as soldiers

Having received with all my heart the Salvation offered to me by the tender mercy of Jehovah, I do here and now publicly acknowledge God to be my Father and King, Jesus Christ to be my Saviour, and the Holy Spirit to be my Guide, Comforter, and Strength; and that I will, by His help, love, serve, worship, and obey this glorious God through all time and through all eternity.

Believing solemnly that The Salvation Army has been raised up by God, and is sustained and directed by Him, I do here declare my full determination, by God's help, to be a true soldier of the Army till I die.

I am thoroughly convinced of the truth of the Army's teaching.

I believe that repentance towards God, faith in our Lord Jesus Christ, and conversion by the Holy Spirit, are necessary to Salvation, and that all men may be saved.

I believe that we are saved by grace, through faith in our Lord Jesus Christ, and he that believeth hath the witness of it in himself. I have got it. Thank God!

I believe that the Scriptures were given by inspiration of God, and that they teach that not only does continuance in the favour of God depend upon continued faith in, and obedience to, Christ, but that it is possible for those who have been truly converted to fall away and be eternally lost.

[322] I believe that it is the privilege of all God's people to be "wholly sanctified," and that "their whole spirit and soul and body" may "be preserved blameless unto the coming of our Lord Jesus Christ." That is to say, I believe that after conversion there remain in the heart of the believer inclinations to evil, or roots of bitterness, which, unless overpowered by Divine grace, produce actual sin; but these evil tendencies can be entirely taken away by the Spirit of God, and the whole heart thus cleansed from anything contrary to the will of God, or entirely sanctified, will then produce the fruit of the Spirit only. And I believe that persons thus entirely sanctified may, by the power of God, be kept unblamable and unremovable before Him.

I believe in the immortality of the soul; in the resurrection of the body; in the general judgment at the end of the world; in the eternal happiness of the righteous; and in the everlasting punishment of the wicked.

Therefore, I do here, and now, and for ever, renounce the world with all its sinful pleasures, companionship treasures, and objects, and declare my full determination boldly to show myself a Soldier of Jesus Christ in all places and companies, no matter what I may have to suffer, do, or lose, by so doing.

I do here and now declare that I will abstain from the use of all intoxicating liquors, and also from the habitual use of opium, ludanum, morphia, and all other baneful drugs, except when in illness such drugs shall be ordered for me by a doctor.

I do here and now declare that I will abstain from the use of all low or profane language; from the taking of the name of God in vain; and from all impurity, or from taking part in any unclean conversation or the reading of any obscene book or paper at any time, in any company, or in any place.

I do here declare that I will not allow myself in any falsehood, deceit, misrepresentation, or dishonesty; neither will I practise any fraudulent conduct, either in my business, my home, or in any other relation in which I may stand to my fellow men, but [323] that I will deal truthfully, fairly, honourably, and kindly with all those who may employ me or whom I may myself employ.

I do here declare that I will never treat any woman, child, or other person, whose life, comfort, or happiness may be placed within my power, in an oppressive, cruel, or cowardly manner, but that I will protect such from evil and danger so far as I can, and promote, to the utmost of my ability, their present welfare and eternal salvation.

I do here declare that I will spend all the time, strength, money, and influence I can in supporting and carrying on this War, and that I will endeavour to lead my family, friends, neighbours, and all others whom I can influence, to do the same, believing that the sure and only way to remedy all the evils in the world is by bringing men to submit themselves to the government of the Lord Jesus Christ.

I do here declare that I will always obey the lawful orders of my Officers, and that I will carry out to the utmost of my power all the Orders and Regulations of The Army; and further, that I will be an example of faithfulness to its principles, advance to the utmost of my ability its operations, and never allow, where I can prevent it, any injury to its interests or hindrance to its success.

And I do here and now call upon all present to witness that I enter into this undertaking and sign these Articles of War of my own free will, feeling that the love of Christ who died to save me requires from me this devotion of my life to His service for the Salvation of the whole world, and therefore wish now to be enrolled as a Soldier of the Salvation Army.

[324] _____

_____CORPS_____ 18___

.....
.....Corps.
.....Division.
.....18...

(Single)
FORM OF APPLICATION
FOR AN APPOINTMENT AS AN
OFFICER IN THE SALVATION ARMY

Name .....

Address .....

1. What was your AGE last birthday? ..... What is the date of your birthday? .....

2. What is your height? .....

3. Are you free from bodily defect or disease? .....

4. What serious illnesses have you had, and when? .....

5. Have you ever had fits of any kind? ..... If so how long, and what kind? .....

6. Do you consider your health good, and that you are strong enough for the work of an officer? .....If not, or if you are doubtful, write a letter and explain the matter.....

7. Is your doctor's certificate a full and correct statement so far as you know?.....

8. Are you, or have you ever been, married?.....

[325] 9. When and where CONVERTED?.....

10. What other Religious Societies have you belonged to?.....

11. Were you ever a Junior Soldier?..... If so, how long?.....

12. How long have you been enrolled as a SOLDIER? and signed Articles of War?.....

13. If you hold any office in your Corps, say what, and how long held?.....

14. Do you intend to live and die in the ranks of the Salvation Army?.....

---

15. Have you ever been an open BACKSLIDER?..... If so, how long? .....

16. Why?..... Date of your Restoration?.....

17. Are you in DEBT?..... If so, how much?.....

18. How long owing?..... What for?.....

19. Did you ever use Intoxicating Drink?..... If so, how long is it since you entirely gave up its use?.....

20. Did you ever use Tobacco or Snuff?..... If so, how long is it since you gave up using either?.....

---

21. What UNIFORM do you wear?.....

22. How long have you worn it?.....

23. Do you agree to dress in accordance with the direction of Headquarters?.....

24. Can you provide your own uniform and "List of Necessaries" before entering the Service?.....

---

25. Are you in a Situation?..... If so, how long?.....

26. Nature of duties, and salary.....

27. Name and address of employer?.....

[326] 28. If out, date of leaving last situation?..... How long there?.....

29 Why did you leave?.....

30. Name and address of last employer?.....

---

31. Can you start the SINGING?.....

32. Can you play any musical instrument?..... If so, what?.....

33. Is this form filled up by you?..... Can you read well at first sight?.....

34. Can you write SHORTHAND?..... If so, what speed and system?.....

35. Can you speak any language other than English?..... If so, what?.....

36. Have you had any experience and success in the JUNIOR SOLDIERS' WAR?.....

37. If so, what?.....

---

38. Are you willing to sell the "WAR CRY" on Sundays?.....

39. Do you engage not to publish any books, songs, or music except for the benefit of the Salvation Army, and then only with the consent of Headquarters?.....

40. Do you promise not to engage in any trade, profession, or other money-making occupation, except for the benefit of the Salvation Army, and then only with the consent of Headquarters?.....

41. Would you be willing to go ABROAD if required?.....

42. Do you promise to do your utmost to help forward the Junior Soldiers' work if accepted?.....

43. Do you pledge yourself to spend not less than nine hours every day in the active service of the Army, of which not less than three hours of each week-day shall be spent in VISITATION?.....

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[327] 44. Do you pledge yourself to fill up and send to Headquarters forms as to how your day is spent?.....

45. Have you read, and do you believe, the DOCTRINES printed on the other side?.....

46. Have you read the "Orders and Regulations for Field Officers" of the Army?.....
If you have not got a copy of "Orders and Regulations," get one from Candidates' Department at once. The price to Candidates is 2s. 6d.

47. Do you pledge yourself to study and carry out and to endeavour to train others to carry out all Orders and Regulations of the Army?.....

48. Have you read the Order on page 3 of this Form as to PRESENTS and TESTIMONIALS, and do you engage to carry it out?.....

49. Do you pledge yourself never to receive any sum in the form of pay beyond the amount of allowances granted under the scale which follows?.....

Allowances—From the day of arrival at his station, each officer is entitled to draw the following allowances, provided the amount remains in hand after meeting all local expenses, namely:–For Single Men: Lieutenants, 16s. weekly, and Captains, 18s.; for Single Women: Lieutenants, 12s. weekly, and Captains, 15s. weekly; Married Men, 27s. per week, and ls. per week for each child under 14 years of age; in all cases without house-rent.

50. Do you perfectly understand that no salary or allowance is guaranteed to you, and that you will have no claim against the Salvation Army, or against any one connected therewith, on account of salary or allowances not received by you?.....

---

51. Have you ever APPLIED BEFORE?..... If so, when?.....

52. With what result?.....

[328] 53. If you have ever been in the service of the Salvation Army in any position, say what?.....

54. Why did you leave?.....

55. Are you willing to come into TRAINING that we may see whether you have the necessary goodness and ability for an Officer in the Salvation Army, and should we conclude that you have not the necessary qualifications, do you pledge yourself to return home and work in your Corps without creating any dissatisfaction?.....

56. Will you pay your own travelling expenses if we decide to receive you in Training?.....

57. How much can you pay for your maintenance while in Training?.....

58. Can you deposit £1 so that we can provide you with a suit of Uniform when you are Commissioned?.....

59. What is the shortest NOTICE you require should we want you?.....

60. Are your PARENTS willing that you should become an Officer?.....

61. Does any one depend upon you for support?..... If so, who?.....

62. To what extent?.....

63. Give your parents', or nearest living relatives', full address.....

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64. Are you COURTING?..... If so, give name and address of the person.....

65. How long have you been engaged?..... What is the person's age?.....

66. What is the date of Birthday?..... How long enrolled as a SOLDIER?.....

67. What Uniform does the person wear?..... How long worn?.....

[329] 68. What does the person do in the Corps?.....

69. Has the person applied for the work?.....

70. If not, when does the person intend doing so?.....

71. Do the parents agree to the person coming into Training?.....

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72. Do you understand that you may not be allowed to marry until three years after your appointment as an Officer, and do you engage to abide by this?.....

73. If you are not courting, do you pledge yourself to abstain from anything of the kind during Training and for at least twelve months after your appointment as a Commissioned Field Officer?.....

74. Do you pledge yourself not to carry on courtship with any one at the station to which you are at the time appointed?.....

75. Do you pledge yourself never to commence, or allow to commence, or break off anything of the sort, without first informing your Divisional Officer, or Headquarters, of your intention to do so?.....

76. Do you pledge yourself never to marry any one marriage with whom would take you out of the Army altogether?.....

77. Have you read, and do you agree to carry out, the following Regulations as to Courtship and Marriage?.....

(a) "Officers must inform their Divisional Officer or Headquarters of their desire to enter into or break off any engagement, and no Officer is permitted to enter into or break off an engagement without the consent of his or her D.O.

(b) "Officers will not be allowed to carry on any courtship in the Town in which they are appointed; nor until twelve months after the date of their Commission.

[330] (c) "Headquarters cannot consent to the engagement of Male Lieutenants, until their Divisional Officer is prepared to recommend them for command of a Station as Captain.

(d) "Before Headquarters can consent to the marriage of any Officer, the Divisional Officer must be prepared to give him three stations as a married man.

(e) "No Officer accepted will be allowed to marry until he or she has been at least three years in the field, except in cases of long-standing engagements before application for the work.

(f) "No Male Officer will, under any circumstances, be allowed to marry before he is twenty-two years of age, unless required by Headquarters for special service.

(g) "Headquarters will not agree to the Marriage of any Male Officer (except under extraordinary circumstances) until twelve months after consenting to his engagement.

(h) "Consent will not be given to the engagement of any male Officer unless the young woman is likely to make a suitable wife for an Officer, and (if not already an Officer) is prepared to come into Training at once.

(i) "Consent will be given to engagements between Female Officers and Soldiers, on condition that the latter are suitable for Officers, and are willing to come into Training if called upon.

(j) "Consent will never be given to any engagement or marriage which would take an Officer out of the Army.

(k) "Every Officer must sign before marriage the Articles of Marriage, contained in the Orders and Regulations for Field Officers."

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[331] PRESENTS AND TESTIMONIALS.

1. Officers are expected to refuse utterly, and to prevent, if possible, even the proposal of any present or testimonial to them.

2. Of course, an Officer who is receiving no salary, or only part salary, may accept food or other gifts, such as are needed to meet his wants; but it is dishonourable for any one who is receiving their salary to accept gifts of food also.

THE DOCTRINES OF THE SALVATION ARMY.

The principal Doctrines taught in the Army are as follows:–

1. We believe that the Scriptures of the Old and New Testament were given by inspiration of God, and that they only constitute the Divine rule of Christian faith and practice.

2. We believe there is only one God, who is infinitely perfect, the Creator, Preserver, and Governor of all things.

3. We believe that there are three persons in the Godhead–the Father, the Son, and the Holy Ghost, undivided in essence, coequal in power and glory, and the only proper object of religious worship.

4. We believe that, in the person of Jesus Christ, the Divine and human natures are united, so that He is truly and properly God, and truly and properly man.

5. We believe that our first parents were created in a state of innocency, but by their disobedience they lost their purity and happiness; and that, in consequence of their fall, all men have become sinners, totally depraved, and as such are justly exposed to the wrath of God.

6. We believe that the Lord Jesus Christ has, by His suffering and death, made an atonement for the whole world, so that whosoever will may be saved.

7. We believe that repentance towards God, faith in our Lord Jesus Christ, and regeneration by the Holy Spirit, are necessary to Salvation.

[332] 8. We believe that we are justified by grace, through faith in our Lord Jesus Christ, and that he that believeth hath the witness in himself.

9. We believe the Scriptures teach that not only does continuance in the favour of God depend upon continued faith in, and obedience to, Christ, but that it is possible for those who have been truly converted to fall away and be eternally lost.

10. We believe that it is the privilege of all believers to be "wholly sanctified," and that "the whole spirit and soul and body" may "be preserved blameless unto the coming of our Lord Jesus Christ." That is to say, we believe that after conversion there remain in the heart of the believer inclinations to evil, or roots of bitterness, which, unless overpowered by Divine grace, produce actual sin; but that these evil tendencies can be entirely taken away by the Spirit of God, and the whole heart, thus cleansed from everything contrary to the will of God, or entirely sanctified, will then produce the fruit of the Spirit only. And we believe that persons thus entirely sanctified may, by the power of God, be kept unblamable and unreprovable before Him.

11. We believe in the immortality of the soul; in the resurrection of the body; in the general judgment at the end of the world; in the eternal happiness of the righteous; and in the everlasting punishment of the wicked.

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[333] DECLARATION.

I HEREBY DECLARE that I will never, on any consideration, do anything calculated to injure The Salvation Army, and especially, that I will never, without first having obtained the consent of The General, take any part in any religious services or in carrying on services held in opposition to the Army.

I PLEDGE MYSELF to make true records, daily, on the forms supplied to me, of what I do, and to confess, as far as I am concerned, and to report, as far as I may see in others, any neglect or variation from the orders or directions of The General.

I FULLY UNDERSTAND that he does not undertake to employ or to retain in the service of The Army any one who does not appear to him to be fitted for the work, or faithful and successful in it, and I solemnly pledge myself quietly to leave any Army Station to which I may be sent, without making any attempt to disturb or annoy The Army in any way, should The General desire me to do so. And I hereby discharge The Army and The General from all liability, and pledge myself to make no claim on account of any situation, property, or interest I may give up in order to secure an engagement in The Army.

I understand that The General will not be responsible in any way for any loss I may suffer in consequence of being dismissed from Training; as I am aware that the Cadets are received into Training for the very purpose of testing their suitability for the work of Salvation Army Officers..

I hereby declare that the foregoing answers appear to me to fully express the truth as to the questions put to me, and that I know of no other facts which would prevent my engagement by The General, if they were known to him.

Candidate to sign here .....

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[334] NOTICE TO CANDIDATES.

1. All Candidates are expected to fill up and sign this form themselves, if they can write at all.

2. You are expected to have obtained and read "Orders and Regulations for Field Officers" before you make this application.

3. Making this application does NOT imply that we can receive you as an officer, and you are, therefore, NOT to leave your home, or give notice to leave your situation, until you hear again from us.

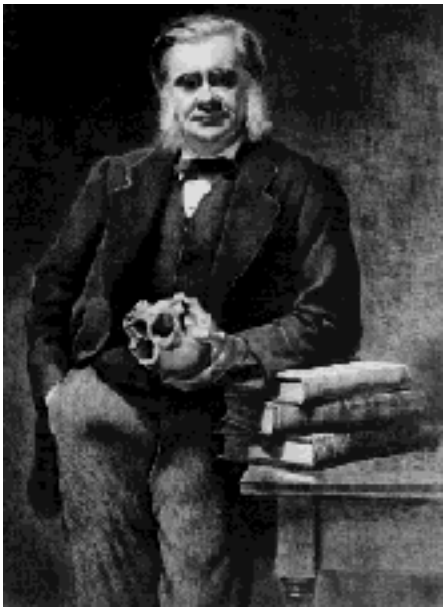
4. If you are appointed as an Officer, or received into Training and it is afterwards discovered that any of the questions in this form have not been truthfully answered, you will be instantly dismissed.

5. If you do not understand any question in this form, or if you do not agree to any of the requirements stated upon it, return it to Headquarters, and say so in a straightforward manner.

6. Make the question for this appointment a matter of earnest prayer, as it is the most important step you have taken since your conversion.

We must have your Photo. Please enclose it with your forms, and address them to "Candidate Department," 101*, Queen Victoria Street, London, E.C*

THE HUXLEY FILE



Preface and Table of Contents to Volume IX, *Evolution & Ethics and Other Essays*, of Huxley's *Collected Essays.*

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