LIFE, LETTERS, AND WORKS
OF LOUIS AGASSIZ

Louis Agassiz
1873

LIFE, LETTERS, AND WORKS

OF

LOUIS AGASSIZ

BY

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WITH ILLUSTRATIONS

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PREFACE.

More than twenty years have passed since the death of Louis Agassiz, and although many biographies were published directly after his death, no true life of him has yet appeared: nearly all have been too eulogistic, while, on the other hand, some rather severe strictures and criticisms have incidentally appeared in articles purporting to give the life of some of his associates, or dealing with some special questions of natural history. Agassiz occupied too large and important a place in natural history not to have left both a certain number of critics and a larger number of enthusiastic admirers ready to see in him only faults or perfection. Truth lies between the two. As one of the reviewers of Agassiz's life by his wife says: "The true history of Agassiz has not yet been written."

To meet this want, I have made during the last twenty years a large collection of material in the form of letters, recollections of friends and contemporaries, and rare pamphlets, with the design of presenting to the public the man himself; his origin, his character, his public life, his private life, his passions, his weaknesses, his faults, his errors, his genius; what he did and what he left undone; above all, to put him in his

place, in a true light, in correct perspective, with its lights and shadows, in the field of the history of natural science.

I have tried to speak of him uninfluenced by the discordant voices which have celebrated his merits without discretion, or demolished his reputation without measure. His faults were small, while his genius was great. "Son envergure immense allant d'un bout à l'autre du ciel scientifique," as was said also of Humboldt and Cuvier.

I enjoyed his friendship during almost thirty years, being one of the few men to whom Agassiz half unbosomed himself; and I am the last survivor of the small band of European naturalists who came to America with him. My admiration of the man is not concealed; but I have had constantly in view the truth, and have tried to be just, not only towards him, but also towards all those who were more or less connected with him during his scientific life.

In the thought of many, a man of genius ought to be perfect; and consequently when errors, mistakes, and faults appear, it is difficult to accept them and bear them with equanimity and indulgence. But we must be generous, and make a fair allowance for human weakness, even in a man of genius, and especially in a man of genius.

Agassiz kept up all his life a very large correspondence, either directly, or when too busy or in ill health, by dictation. In Neuchâtel he wrote at least five letters daily, not only to naturalists, savants in general, and to his relatives, but also to other friends, and

even statesmen and historians like Thiers and Guizot in France, and later to Dom Pedro II, in Brazil. The number of his letters is enormous, and until 1842 he kept copies of them all. I know of one of his correspondents who received more than one hundred letters from him. To choose among them is not an easy task. Mrs. Agassiz, in the life of her husband, has given a certain number (about ninety), selecting more especially those addressed to Agassiz's mother, father, and brother, and to some well-known men of science, philosophers, philanthropists, and politicians; besides giving letters written to Agassiz by naturalists like Humboldt, Cuvier, Buckland, Sedgwick, Lyell, etc. Unwilling to repeat what has been already so well done by Mrs. Agassiz, my quotations are limited to letters of Agassiz, addressed to practical naturalists, his contemporaries, working on kindred subjects. To see and appreciate the influence exerted by Agassiz on the progress of palæontology, geology, and the glacial question, it is important to show his impressions at the very moment when he received them in the course of his studies.

I have received much information, and copies of letters and notes, from persons or families formerly in correspondence with Agassiz. I beg them to receive my thanks; and I have especially to thank my good friend, M. Auguste Mayor, of Neuchâtel, first cousin of Agassiz. Although some years younger than Louis Agassiz, he knew him as a very young man, and followed closely his eventful and splendid career during his whole life, both in Europe and in America,

for M. Mayor lived for more than twenty years in Brooklyn, New York, and received Agassiz at his house when he came to the New World. Each had perfect confidence in the other; as cousins and friends they loved one another without reserve. For myself, I cannot separate Louis Agassiz from Auguste Mayor. Such friendly and constant relations in both hemispheres between two men are extremely rare.

I have carefully read and considered all documents, and have made constant use of my intimate knowledge of Agassiz. Scientifically we did not agree on all points; but both were satisfied to accept our differences of opinions. On the whole, our friendship was never shadowed by a single serious disagreement.

The biography of such a man as Agassiz cannot be given by the publication of his letters only; because in letters the confidences are not so free, precise, or so full as can be desired: besides, many letters, for various reasons, cannot be published in full. Agassiz's genius was so spontaneous, so frankly natural, so absolutely sincere, that his physiognomy was most attractive, showing always the great mobility of his sentiments. He was one of those very few men whose works are not sufficient to make him entirely known; one must meet him face to face. Agassiz was so full of personal inspiration and original thought, that in order to have a just idea of him, naturalists went to Neuchâtel, and afterward to Cambridge, only to see him, and shake his hand. His individuality was a subject of continual observation by all those who surrounded or approached him. He was of an extremely rare and very complex

type. It is impossible to group round him other naturalists, and to form a special class of spirits related to his. He surprised every one by his constant watchfulness, and his quickness to get at the truth of nature. Agassiz himself was more interesting than his works. His life is a rare study.

Until 1838, he wrote with his own hand an enormous amount of manuscript; nothing discouraged him, and he was always ready to use his pen, even to copy papers or books which he was too poor to purchase, or which it was impossible to procure otherwise. He kept a private journal, in which he wrote with great *naïveté* everything which occurred to him, or came under his eyes, when at Bienne, Lausanne, Zürich, Heidelberg, Orbe, Munich, Concise, Paris, and during the first two years of his life at Neuchâtel. He showed me this journal, and I had the privilege of reading in it some of his student adventures and escapades. I do not know what has become of the manuscript.

Agassiz, from his youth until his last illness, was overflowing with intellectual spirit and vitality. He is a rare example of manly qualities and activities. His influence on the progress and diffusion of natural history is second to none.

I have tried to bring him before the reader as I have known him. If I do not produce an exact portrait of the man and his life, it is due simply to my inability to express my feeling for the man and his works. Born at the foot of the Jura Mountains like Agassiz, and not far from his birthplace, I passed my youth and was educated under much the same circumstances as he,

and ought to be able to deal with the difficult task of writing his biography, for I have had unusual opportunities to know him and his surroundings in the Old and New Worlds. I can truly say that the task of writing his life has been a work of friendly love and respect for the man, and of justice to the savant.

My aim has been constantly to make a judicious blending of history, correspondence, and extracts from his works, and of the estimation in which these are held by others. Mrs. Agassiz's account of her husband's life gives the character of Agassiz by means of a list of qualities rather than a complete picture. As is very likely to happen, her biography is rather a panegyric than an analysis of character. I have her example constantly before my eyes, in my endeavour not to fall into the same error; as Massimo d'Azelio says: "I must be honest, not only with the reader, but with myself; otherwise I should be treating the life of Agassiz like a half-decayed peach, the spoilt part of which I should cut out, and present only the sound portion."

Without passing over in silence the moral failings of the man, and the inequalities of talent of the naturalist, I have expressed all my admiration for this master of natural history. The unity which is not to be found in his acts or in his works will be found in his iron will; he had a fixed idea — he wished to be the "first naturalist of his time," as he said in a letter to his father, when he was still a student at Munich.

Although Agassiz was very ready to care for his own interests, he never was a practical man, in the full business sense of the word. Unable to choose suitable

men as assistants and co-workers, he was very prompt to make use of them, whenever they were competent.

I shall finish with a French sentence, very appropriate to the Franco-Swiss savant, educated as a naturalist in Germany, a constant admirer and pupil of Cuvier, and finally a naturalized American. Agassiz "restera une personnalité populaire et sympathique. À mesure que ses défauts et ses faiblesses diminuent dans l'éloignement, ses qualités maitresses apparaissent plus éclatantes et font oublier tout le reste: il avait la foi, la vie, la chaleur, l'enthousiasme, la passion, et surtout ce qui le rendait éminement sympathique, il ne connaissait pas le fiel, l'envie, la rancune et la haine."

CAMBRIDGE, MASSACHUSETTS,
March, 1895.

INTRODUCTION.

FRENCH was the native tongue of Louis Agassiz. His remarkable and admirable mother knew neither English nor German, but wrote French with great purity and choice of expression. As one of the family in Switzerland writes me, "ses lettres sont charmantes, elle écrivait à merveille." All the great works of Agassiz, on which his reputation as an original naturalist is based, are in the French language. The most active part of his life, as regards great discoveries, was spent at Neuchâtel, then a small town, where French is the only language spoken. Before he came to America, all his correspondence with English naturalists was in French; so that it is almost impossible entirely to suppress this language in writing an accurate and true life of him. Translations, however good, never give an exact idea of what the author means, especially in the case of difficult and delicate observations in natural history.

After long consideration, I have, therefore, concluded to give what I quote of his correspondence in the original. All English-speaking naturalists read French now. As the interest of such a book is limited to naturalists and persons whose education leads them to read and

appreciate the life of an extraordinary man, a few letters and quotations in French, scattered through the work, will present no difficulties to its readers. On the contrary, they will be a sort of stimulant and a relish, both scientifically and from a literary point of view.

For the same reason, an address — the most important of the many delivered by Agassiz — has been reproduced in the original. It is his celebrated discourse of 1837, on a "Great Ice-age."

During the period from his twenty-third to his fortieth year, Agassiz wrote many letters in German, mainly of a private nature, addressed to members of his German family or to a few most intimate friends. Almost all his scientific letters were directed to his old professor at Heidelberg, H. G. Bronn, and have been published in the "Neues Jahrbuch für Mineralogie, Geologie und Petrefaktenkunde." Although he was a perfect master of German, speaking and writing it like a native of Heidelberg or Munich, he never published important papers in that language, only a few pamphlets, the principal one being his reply to Karl Schimper's claims, 4 pp. 4to.

Agassiz's remarkable personality cannot be properly understood without taking into account the strength of his French nature. A Franco-Swiss he was born; and a Franco-Swiss he remained all his life, notwithstanding his American naturalization and his great admiration of the New World in general, and of the United States in particular.

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CHAPTER I.

1807–1827.

ANCESTRY — ORIGIN OF THE NAME AGASSIZ — COAT-OF-ARMS — BOYHOOD — MOTIER-EN-VULY — REPUTATION OF LOUIS'S FATHER AS A TEACHER — COLLEGE OF BIENNE — VINTAGE-TIME AT MOTIER — SOME PECULIARITIES IN THE CHARACTER OF LOUIS AGASSIZ — COLLEGE STUDIES AT LAUSANNE — HIS RESOLUTION TO BE A NATURALIST — UNIVERSITY OF ZÜRICH — HIS FIRST TEACHER OF ZOÖLOGY, M. SCHINZ — "FIRST AT WORK AND FIRST AT PLAY!" — UNIVERSITY OF HEIDELBERG — ALEXANDER BRAUN, KARL SCHIMPER, AND AGASSIZ — FIRST VISIT TO THE BRAUN FAMILY AT CARLSRUHE — TYPHOID FEVER — HIS STAY AT ORBE.

THE Agassiz family came originally from Orbe and the small village of Bavois, in the "Jura Vaudois." A little west of Orbe there is a small hamlet, called Agiez or Agiz. In old French, and more especially in the patois of the Canton de Vaud, Agiz, Agiez, Agasse, Agassiz, and Aigasse[1] mean "magpie," a bird which was and is still very common in the country around Orbe and La Sarraz. In low Latin, magpie is Agasia; in Provençal, Agazia, or Agassa, and Agasse; while in Burgundy and Franche-Comté it is Aiguaisse. Obvi-

[1] "Agassiz ou Agasses ou Agaisse; dans toute la France ces trois noms signifient Pie. Autrefois Agassiz s'écrivait un peu différement Agacie. C'était un surnom donné jadis aux querelleurs, dit-on, et aussi aux grands causeurs. — On sait combien la Pie est jaseuse." (See "Dictionnaire des noms," par Lorédan-Larchey, p. 4, Paris, 1880.)

ously the name of the family was derived from the name of the bird; as evidence of this, the old armoiries or coat-of-arms of the Agassiz family is a black magpie on a silver ground (*Pie noire sur fond d'argent*), a drawing of which may be seen on the title-page. It is still preserved in the family in Switzerland, which also possesses an old seal, engraved on copper, with the same bird in the centre. Formerly, among all French-speaking peoples it was the custom for ennobled burghers to adopt for their coat-of-arms what was called "armes parlantes," and the Agassiz of Orbe chose the magpie.

Originally, the name was doubtless given to one inclined to talk a little too much, — as the French proverb has it, "bavard comme une pie."

One of the most faithful correspondents and best friends of Agassiz, Sir Philip de Grey Egerton, the great English paleoichthyologist, an excellent French scholar, used often to call him "Mon cher Agass" as a reminder of his knowledge of old French and patois.

The name Agassiz is not very rare, and is found among French people not connected in any way with the original family of Louis Agassiz. However, a branch of his family emigrated to London, and some fifty or more years ago a family of bankers of the name of Agassiz was there, who occasionally corresponded with their relatives of the Canton de Vaud. One of them published, in 1833, a book of travels under the title, "Journey to Switzerland and Pedestrian Tours in that Country" (London, 8vo), a work which is sometimes wrongly attributed to Louis Agassiz.

At the beginning of this century there was in Paris a M. Agasse, a publisher and bookseller, who published in 1804 the third edition of "La Flore française," by Lamarck and De Candolle.

The celebrated La Fontaine, in his fable "L'Aigle et la Pie," says: —

"L'aigle, reine des airs, avec Margot la pie,
Différentes d'humeur, de langage, et d'esprit,
Et d'habit,
Traversaient un bout de prairie.
Le hazard les assemble en un coin détourné.
L'Agasse [1] eut peur; mais l'Aigle ayant fort bien diné,
La rassure, et lui dit: 'Allons de compagnie;
Si le maître des dieux assez souvent s'ennuie,
Lui qui gouverne l'univers,
J'en puis bien faire autant, moi qu'on sait qui le sers.
Entretenez-moi donc, et sans cérémonie.'
Caquet-bon-bec alors de jaser au plus dru,
Sur ceci, sur cela, sur tout. L'homme d'Horace,
Disant le bien, le mal, à travers champs, n'eut su
Ce qu'en fait de babil y savait notre Agasse."

The name is also found in Italy, but omits the *s* at the end.

In the Arabic or Mauresque and Saracenic language the expression "Kol-Agassiz" means *wing-leader*, a sort of field officer occupying a position between captain and major, called in Turkish "Bin-Bashi." So in Arabic Agassiz means *conductor, leader*. The origin of the Swiss name evidently differs from that of the Mauresque and Saracenic word.

[1] "Agasse, vieux mot qui vient de l'italien *gazza*, signifiant Pie."

That the Agassiz were descendants of French Huguenots, and were obliged to leave France at the revocation of the "édit de Nantes," is a tradition without any solid basis of fact to rest upon. Indeed, the name Agassiz existed as far back as the thirteenth century in the Canton de Vaud; but it is impossible to trace the family, because all the papers belonging to the Agassiz were destroyed in a fire at the parsonage of Constantine, in the Canton de Vaud, where the grandfather of Louis was settled as pastor, — a profession followed in the family for five generations.

Very likely an Agassiz married a French Huguenot; for at the time of the revocation the French Protestant exiles flocked into Switzerland, and settled in large numbers at Orbe and in the environs; almost completely filling the villages now known as Ballaigues, Vallorbe, and La Vallée de Joux, and it is possible that an Agassiz married among them; which may account for the tradition.

There is much to favour the belief in a connection of the Agassiz with some French family of the Cevennes, or of Provence; for the extraordinary imagination of Louis Agassiz points to a close connection with the children of sunny Provence, so well portrayed by Alphonse Daudet in his series of romances on Tartarin of Tarascon.

The family features are, however, entirely Swiss, and even Jurassic. In general, they are broad shouldered, thickly built, bony, with fair-coloured faces, and rather slow in their movements, — a type very frequently met all along the foot of the mountains of the Jura, more

especially from Bienne down to Orbe and "la perte du Rhône."

The father of Louis was called Rodolphe Benjamin Louis; he was born March 3, 1776, and died Sept. 6, 1837. His mother, Rose Mayor, was born July 11, 1783, and died Nov. 11, 1867. Jean Louis Rodolphe Agassiz was born May 28, 1807, at the parsonage of Motier-en-Vuly, on the Lake of Morat, Canton of Fribourg. He was the fifth child, but the four others having died in their infancy, Louis Agassiz was the eldest child. As is the custom among all French-speaking people, he never used his full Christian name, but signed himself simply Louis Agassiz.

At the beginning of this century, and before coming to the parish of Motier, his father had been pastor at St. Imier, then a very poor and remote valley, lost among the mountains of the Jura. The loss of his children, one after another, and the great isolation of St. Imier, far away from his kindred and friends, led him to look for a better parish, and, in 1806, he came to Motier,[1] first as a "suffragan" (assistant) of the titular minister, J. R. Martin; afterward, on Aug. 31, 1810, he was elected "pasteur" (minister).

The parish of Motier consists of four small villages, located at the eastern foot of Mont Vuly, on the Lake of Morat, and containing in all five hundred inhabitants. Singularly enough, Vuly belongs to the Roman Catho-

[1] The name is sometimes spelled Môtiers, and to distinguish it from another Motiers in the Val Travers, it is called Motier-en-Vully. The spelling varies as well for Vully as for Motier, Motiers, or Moutiers, and is written sometimes Vuilly, Vuly, or Vully.

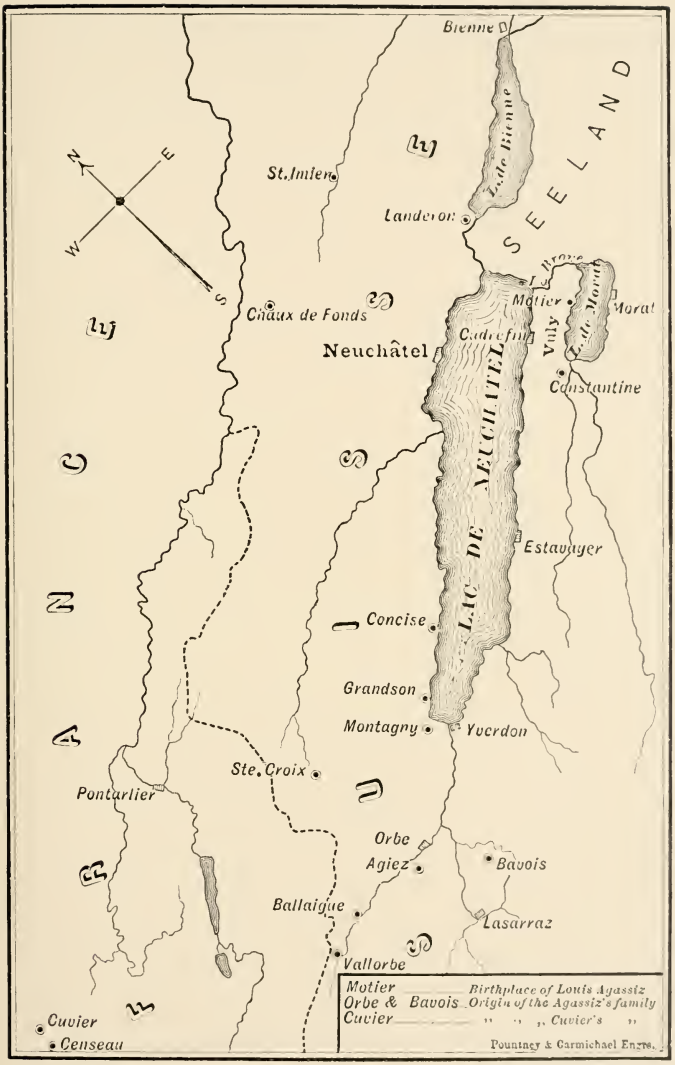
lic Canton of Fribourg; but in consequence of its situation on the extreme frontier of the Canton of Berne, it was invested with the right of com-burghership, "combourgeoisie," with Berne.

When, in 1530, the celebrated reformer, Farel, succeeded in converting the parish of Motier, the council of Fribourg complained to Berne of his preaching in the Vuly; deputies were sent therefore from Berne to meet at Morat together with four delegates from the four principal villages of the Vuly, who concluded to put the matter to vote under the direction of "Messieurs de Berne."[1] The reform movement received the majority of votes in the four villages of the Motier parish, and it has ever since been Protestant, notwithstanding the fact that it belongs to a very strong and uncompromising Catholic canton.

The Vuly is situated at the extreme end of a promontory, surrounded by water on three sides; on the east by the Lake of Morat, on the north by the river La Broye, and on the west by the Lake of Neuchâtel. The *Seeland* of Berne, comprised between Kersers, Treiten, Aarberg, and Bienne, constitutes, with the lakes of Morat, Neuchâtel, and Bienne, a very extensive sheet of water.

As soon as the young couple had left the trying climate of St. Imier, with its long and very cold winter, and had settled in the fine agricultural district of the Vuly, with its vineyards and orchards, prosperity and happiness greeted them from every direction. Four

[1] A name formerly used among the Swiss who speak the French language to designate all those in authority in the Canton of Berne.



Sketch Map of Part of Switzerland.

healthy children — two sons, Louis and Auguste, and two daughters, Olympe and Cecile — were born to them; and although the parish was small and consequently of limited means, it was most gratifying to find themselves among relatives and friends; for pastor Agassiz had resided for some time at Constantine, a village near Avranches, where his father was minister, and it was during his stay there that he became acquainted with Miss Rose Mayor, his future wife, who was a daughter of the country physician at Cudrefin, a village only a few miles distant from Motier. It may be said that the inhabitants of the whole peninsula of Vuly, Cudrefin, and Constantine, greeted pastor Agassiz and his wife, as their own people returned.

Born and educated in such a place as Motier, surrounded by water and marshes, with the Oberland always in full view in front, and the summit of the Jura in the rear, it is no wonder that Agassiz became an ichthyologist and a glacialist. Everything which met his eye, from infancy until manhood, seems to have awaked in him a curiosity to know his surroundings. It was as natural for him to take to the study of fishes and of glaciers as it is for sons of seamen to go to sea, or for "vignerons" (vine-dressers) to go to the vineyard, or for the "gauchos" to ride on the prairies of South America, or for the Arabs to cross the desert on camels. It might almost be said that Louis Agassiz, as we shall see more fully by and by, was a remarkable instance of atavism of the Swiss lake-dwellers of prehistoric time.

Almost as soon as he was able to move alone, he

took naturally to water, like a young duck. All the fishermen became at once very fond of the little fellow, and there was a friendly rivalry among them to get him into their boats and show him how to catch fish. In a relatively short time he became a great favourite, and every one wanted to show the parson's son those neighbourly attentions which are of daily occurrence, and form a part, and an important part, of life, among all the country people residing in such isolated places as the Vuly.

A part of the duty of a minister in Switzerland is to look after the schools and even to take a part, and often not a small one, in the teaching. Parson Agassiz was a very successful and excellent teacher; indeed, in all his parishes, both at St. Imier and at Motier, and afterward at Orbe and Concise, his reputation as a teacher was far superior to his reputation as a preacher.

Louis was by far the best pupil of his father; for not only did he learn from him the elements, and lay an excellent foundation for his future education, but he caught from him his method of teaching, which was based entirely on the interest he always tried to awaken among his pupils in the subject of study. There is no doubt this was a family inheritance, and that it developed and attained its maximum with Louis. It may be said that Louis Agassiz was born with a true passion for teaching, as truly as that he was born a naturalist. As we shall see, he remained a teacher until the end of his life, changing his subjects of studies quite often, and showing a rather capricious character in many ways, except in his unalterable love of teaching.

Next to his passion for teaching, but developed before it, was his passion for collecting all sorts of objects belonging to natural history. As soon as he was able to catch fish, he brought them alive and placed them in a great stone basin of the fountain of the parsonage.[1] It is the custom in the Canton de Vaud and the neighbouring Swiss cantons to use boulders for basins, either to receive the water flowing from springs, or to hold the fruit of the vintage when the grapes are brought from the vineyard to be pressed and converted into wine. These boulders are generally of Alpine granite, and are cut into the proper shape, great care being taken not to break them, but to keep the block one great monolith. Such an Alpine boulder was the basin of the Motier parsonage, used as a *vivier* or aquarium by our young ichthyologist. It is not strange that, later in life, Agassiz became such an expert in boulders transported by glaciers; and it seems specially appropriate that one of them, transported from the Alps, should be his tombstone in America.

At the age of ten years, he was sent to the College of Bienne, to begin his classical studies; finishing them at the Academy of Lausanne in 1822–1824. He was a very clever student, but never had much inclination for mathematics and the physical and chemical sciences. He always showed great capacity for languages, becoming quite proficient in Latin and Greek, and when at Bienne, learning German and Italian, especially the

[1] "Le fils d'un pasteur du Canton de Vaud, dont le père, ne savait que faire *de ce garçon courant toujours les champs et toutes les rives du Lac à chercher des bêtes*," as one of the contemporaries of his youth said.

former, which he spoke like a native. Geography was another favourite study.

His brother Auguste, younger by two years, joined him, a year later, at the College of Bienne, and the two brothers kept together during all their classical studies. The distance between Motier and Bienne — about seven leagues — was always made on foot; and, considering their extreme youth, it was quite a journey for such little fellows. But they were excellent walkers; and though at first the route was difficult, further on they crossed over the "Seeland," or marshy country, and the western shore of the Lake of Bienne, and reached their destination in eight hours, not over-fatigued. I heard both say, many years after, that it was shorter and easier to go home from Bienne than it was to go to the college at Bienne from home. Going home to pass the vacations was, of course, such an attraction that the roads seemed neither so long nor so dirty; besides, these journeys always happened at a fine time of the year; for college vacations then in all the Jura region were during the fall, from the first of September to the first of November. Louis's great strength and already vigorous vitality are finely illustrated by two anecdotes: Arriving quite unexpected from Bienne with his brother, he learned at Motier that his sisters with their cousins Mayor were at their grandfather's house at Cudrefin. At once he started again; but on his arrival at Cudrefin, he found all the young ladies enjoying a bath in the lake, at some distance from the shore. In order not to lose a moment, he jumped into the water with his clothes on, that he might the

more promptly greet and kiss sisters and cousins, — the latter especially, for with one of them he was already in love; and to express his great admiration for this cousin he could find nothing better to do than to have her name tattooed on his left arm with sulphuric acid. The result was a severe attack of fever, and two or three weeks of forced inaction and rest for his arm, which betrayed his act to the whole family.

The two brothers divided their vacations between Motier and Cudrefin, where they enjoyed all the freedom of country life and the comforts of home and family surroundings. Their time was passed in fishing, rambling about with their grandfather, Dr. Mayor, in his daily excursions as a country doctor, in gathering in the second crop of hay, called "regain," and in the "vendanges." This last occupation was the most pleasing; for when the vineyards were richly laden with grapes, the labourers of the Canton of Berne — where there are no vineyards on account of the severity of the climate — gathered by troops from all around the shores of the Lake of Neuchâtel, to offer themselves as "vendangeurs," or vintagers, during the time of the gathering of the grapes and the process of crushing the juice under the "pressoir." It was a true festival, when everybody, young and old, was happy, singing throughout the day and calling from vineyard to vineyard. In the evening at supper, all the "vendangeurs" sat at the table with the proprietors, and the most proficient singers were called, one after another, to sing popular songs, which were closed in chorus by the whole company. Light wines were used very freely

and the cups were continually filled and emptied during these very joyous and friendly repasts. For it must be kept in mind that the same labourers used to come every year, and the meetings were more or less reunions of old acquaintances, always full of reminiscences of preceding years.

Mingling so freely with the people round him, it would seem that Louis must have become an expert in horsemanship and the use of firearms, like almost all young men raised in country places in Switzerland. But this was not the case. Trusting to his great powers of swimming, and led on by his love for fish-catching, Louis was always ready to embark on skiff or raft of any sort. But on land it was very different. In Switzerland no one ever saw him on horseback; and it is doubtful if he ever tried to ride, except once in Brazil. All his life he invariably declined to mount horse or mule. As to shooting, he never possessed firearms, and never joined a shooting club, and probably never fired a single shot during his life in Europe. He is a very remarkable exception among the Swiss of the present century, for he never performed any military service. The great "Tirs Fédéraux" never attracted him, and his passion for natural history never carried him so far as to shoot birds or animals of any sort.

Curiously enough, when a student at the universities of Zürich, Heidelberg, and Munich, he became a great fencer; and one of his contemporaries and friends writes me that Agassiz was an excellent swordsman, using the rapier with great dexterity, and very ready

to make use of it when discussions degenerated into quarrels and obliged the contestants to be called out. At Munich especially he was well known on account of several duels, which he fought to his credit and always successfully.

At the age of fifteen, it was decided that he should enter, as a clerk, the commercial house of his uncle, François Mayor, at Neuchâtel. But on account of his ability as a scholar, he was allowed to finish his college studies at Lausanne, where he studied "belles lettres" and the humanities for two years, 1822–1824. It was during his stay at Lausanne that he gave the first indication of the possession of the characteristics which afterward developed so strongly in him as a savant and as a man. Another of his uncles, Dr. Mathias Mayor, had great reputation as a physician, and a large practice at Lausanne and in all Romande Switzerland; and from him Louis learned the elements of anatomy. At the same time, he had his first opportunity to see a small museum of natural history, the Cantonal Museum, directed by Professor D. A. Chavannes, an entomologist of some note. The Helvetic Society of Natural History, founded at Geneva in 1816, had already collected a small band of Swiss naturalists of great talent, and Agassiz, during his stay at Lausanne, had the good fortune to meet Jean de Charpentier, director of the salt mines of Bex. He was much impressed by the fine face and splendid intellect of de Charpentier; a rare and perfect type of savant; and, influenced by the impression he received from his uncle, Dr. Mayor, Jean de Charpentier, and Professors Lardy and Chavannes, he resolved to be-

come a naturalist; and, as the only way of accomplishing this, he asked his father to let him study medicine, his ambition at that time being to become a country doctor, with full time and opportunity to study the natural history of the Canton de Vaud.

Agassiz was a rather precocious young man; and coming to the age of manhood, he was at once a great admirer of the fair sex. It had always been a characteristic of the Agassiz family, well known among their kin of the Canton de Vaud; and Mrs. Rose Agassiz, who knew the family better than any one, and was always of a practical and far-seeing turn of mind, as far back as January, 1828, in one of her letters to Louis, says: "The sooner you have finished your studies, the sooner you can put up your tent, catch your blue butterfly, and metamorphose her into a loving housewife."[1] The unusual case of the old pastor Rudolphe, the grandfather of Louis, who married a second time at the ripe age of sixty-six years, was much commented upon at the time in the commonwealth.

In 1824 Louis went to the University of Zürich to pursue the medical course and prepare to become a doctor. Zürich was an old centre of culture, and he found there genial surroundings. The professor of natural history, Schinz, at once saw the rare qualifications of Agassiz to become a naturalist, and gave him every opportunity for the study of ornithology, which was his favourite branch. At Lausanne, although a very brilliant student, he was not so much above his

[1] "Louis Agassiz," by Mrs. E. C. Agassiz, Vol. I., p. 62.

comrades, for the Vaudois youth are almost all very bright and remarkably intelligent; but at Zürich it was different. The students there were, for the most part, German Swiss, rather slow, quiet, steady in their work, and not apt to awaken interest of any sort. Agassiz at once attracted the attention of all the students by his quick perception, his witty remarks, and more especially by his constant show of varied knowledge. One of them, many years after, said to me, "Agassiz knew everything, and he was always ready to demonstrate and speak on any subject. If it was a subject which he was not familiar with, he would study and rapidly master it; and on the next occasion, he would speak in such brilliant terms and with such profound erudition that he was a source of constant wonder to all of us."

At Zürich, Agassiz not only enjoyed the teaching of the zoölogist Schinz, but he also often saw the geologist Gesner Escher, the celebrated engineer of the Linth River, and became a great friend of his son, Arnold Escher von der Linth; a friendship which lasted all their lives, notwithstanding great difference of character and even of opinion, Arnold Escher being an observer in the field, while Agassiz was more of a laboratory, museum, and lecture-room man.

Not only did Louis Agassiz astonish his fellow-students at Zürich by the variety of his knowledge, but he was also a wonder to them in his capacity as a pleasure-seeker. At "Kommers" he was always first to come and last to go, his strong constitution requiring an absorption of food and drink which left all the others far behind him, and won for him the reputation

of being what the French call a "belle fourchette," or one who wields a good knife and fork. From this time he took for his motto, "First at work, and first at play," and carried it through all his life, with rare interruptions. Such an ambition required a Herculean constitution, which he certainly possessed; but notwithstanding his strength, this burning of the candle at both ends no doubt finally shortened his life.

In 1826, after two years at Zürich, Agassiz went to the University of Heidelberg, where he stayed eighteen months. There he made acquaintances which influenced him as much as he could be influenced for the rest of his life. His studies took a more decided direction toward natural history, under the leadership of Professors Tiedemann (in comparative anatomy), Leuckart (in zoölogy), Bischoff (in botany), and H. G. Bronn (in geology and palæontology). While attending the lectures of Tiedemann and Bischoff, Agassiz became acquainted with Alexander Braun and Karl Schimper, two very brilliant botanical students; and they very soon became congenial and inseparable companions, not only during their courses at Heidelberg and afterward at Munich, but even during the first decade after leaving the universities.

Alexander Braun was the son of the postmaster-general of the Grand Duchy of Baden, who resided at Carlsruhe. As Heidelberg was very near Carlsruhe, Braun took home with him his three friends, — Agassiz, Schimper, and Imhoff (afterwards a distinguished entomologist of Bâle), — to pass their vacations. It was a great time, not only for the four intimate young

naturalists, but also for the inmates of the house of Postmaster-general Braun. Besides a family of four children, two sons and two daughters, there was living in the family a young Swiss student, Arnold Guyot of Neuchâtel, then learning the German language, and preparing for the ministry. Postmaster-general Braun was very scientific in his tastes, and possessed one of the best collections of minerals then existing in Germany. His house, near one of the city gates, was large enough to admit and lodge comfortably all this company of young people, who rambled through the forests and fields, ransacking every corner where plants and animals were to be found. They had special rooms devoted to dissections, true laboratories; and here they brought their specimens, and for hours together discussed and theorized on all kinds of natural-history subjects.

I shall, farther on, speak at length of Alexander Braun and his younger brother Max, and also of Karl Schimper; but for the present I need only say that the two daughters, Emmy and Cecilia, were both very attractive, and soon received marked attentions, which afterward changed into courtship, from two of the visitors, Louis Agassiz and Karl Schimper. The younger, Miss Cecilia, or "Cily," as she was familiarly called, possessed a remarkable talent for drawing, and would have become an artist of repute if she had devoted her life to the fine arts. She was very sensible, affectionate, and unaffected, and soon felt the influence of Agassiz's attractive personality. Her talent for drawing was constantly brought into demand by the specimens

of natural history which they collected; and when, in the spring of 1827, Agassiz was brought back to Carlsruhe a convalescent, after a very severe and dangerous illness of typhoid fever, the care bestowed on him by the whole Braun family, and more especially by Miss Cecilia, resulted in an engagement of marriage. During his sickness at Heidelberg, Alexander Braun did not leave him until he took him to his father's house at Carlsruhe, as soon as his convalescence allowed his removal. Later he accompanied him to Orbe, in Switzerland, where Agassiz's parents were then living, and left him only when he saw him rapidly gaining health in the life-giving air of the "Jura Vaudois," the native country of the Agassiz family.

As soon as he had recovered sufficiently to walk about, Agassiz, who always was an excellent pedestrian, began to explore the environs of Orbe, as a naturalist, collecting plants, insects, and his dear fishes; for he never lost sight of fishes for any length of time. The Jura Vaudois, during the summer months, is one of the most beautiful countries to visit, and, received as he was with great pleasure, as a guest at the houses of the pastors of Ballaigues, Vallorbe, Beaulmes, Ste. Croix, and other places, he was enabled to make a thorough exploration of Mount Suchet, 1591 metres in height, of the Dent de Vaulion, 1486 metres, of the Aiguilles de Beaulmes, 1563 metres, and of the valley of the Orbe River. At this time he first felt that love for the Jura Mountains which lasted until the end of his life. It was during this stay at Orbe that he wrote his first essay in natural history, a catalogue of all the plants

growing in the Jura Vaudois. I do not know that it was ever published. I was led to think that it was, when Agassiz, speaking many years after of the Suchet Mountain, which he remembered with the freshness of a young man who has just visited them, said to me, "Do you know, it was the first work I did in natural history — an entirely botanical one." I have been unable to discover the work, however, and no one of his Swiss family has ever heard of it. It is only just to say that he was much helped in his botanical explorations round Orbe by the "suffragan," or assistant pastor of his father, Marc Louis Fivaz, like Agassiz an enthusiast in natural history. Fivaz soon abandoned all his researches in natural history, however, although he held the professorship of botany at the Academy of Lausanne, and became a voluntary evangelist in the interior of the west of New York, where he lived, in Tioga County, until his death.

This summer of 1827, when he had just attained his twentieth year, gave Agassiz his first real opportunity to work as a naturalist; and, as was always his custom in later life, he induced those around him to help him in collecting specimens and in making drawings. Besides his friend Marc Fivaz, who accompanied him in all his excursions, he put his younger sister, Cecile, to work drawing fishes and butterflies. His first two artists of natural history specimens, therefore, were two *Ceciles*, — the first, Miss Cecilia Braun, and the second, Miss Cecile Agassiz, his own sister, and the sister of his friend Braun.

CHAPTER II.

1827–1831.

Journey from Carlsruhe to Munich — His Evolution from a French-Swiss to a German Student — His Duel at Heidelberg — University of Munich — Doctor of Philosophy — Martius's Proposal to publish Spix's Fishes from Brazil — Publication of His First Great Work on Natural History — Doctor of Medicine and Surgery — Beginning of His Researches on the "Poissons Fossiles" — His Method of publishing His Works — His Desire to be the First Naturalist of His Time — Visit to Vienna — Return Home with Artist Dinkel — Life at Concise — Christinat — Opportune Help for a Trip to Paris — His Journey "en Zig-zag" by Way of Carlsruhe.

In the autumn, Braun wrote him about changing their place of study from Heidelberg to Munich. The attraction there was, that according to Döllinger, the instruction in the natural sciences left nothing to be desired. Accordingly, Agassiz left Orbe toward the end of October, 1827, and joined Braun at Carlsruhe, where he was welcomed by the whole family of the postmaster-general of Baden, more especially by Miss Cecilia, who had taken such good care of him when convalescent during the previous journey, and who had already made an excellent portrait of him, in coloured pencil or pastel, during the vacation of 1826.[1]

[1] "Portrait of Louis Agassiz at the Age of Nineteen," as frontispiece of "Louis Agassiz, his Life and Correspondence," by E. C. Agassiz, Vol. I.

On their way on foot to Munich they stopped first at Stuttgart, where the Royal Museum, already quite prominent, attracted much of the attention and even admiration of Agassiz. A splendid North American buffalo, and a piece of the hide of a Siberian mammoth, with hairs still attached, excited his wonder and his imagination; for he thought that the mammoth's teeth showed that it was a carnivorous animal; but the question that interested him most was, how this animal could have wandered so far north, and in what manner he died, to be frozen thus, and remain intact, perhaps for countless ages. He little realized that it was reserved for him some day to give the explanation, and that he was to be the god-father of the "Ice-age."

At Esslingen, Agassiz and Braun stopped to visit two botanists, and make exchanges of specimens. As Agassiz had a good collection of dried plants from the Jura Vaudois, and Braun of the Palatinate, they presented themselves, each with a package of dried plants under his arm, and were well received; more especially by Professor von Hochstetter, the father of the afterward celebrated naturalist, Ferdinand von Hochstetter of the "Novara" expedition round the world, and first director of the great Natural History Museum of Vienna.

On the fourth of November, 1827, Agassiz and Braun alighted at Munich; and a few days afterward they were joined by the other member of the *trio* of friends, Karl Schimper. Until then Agassiz had remained a true Swiss; his stay at Heidelberg had not been long enough nor successful enough, on account of his health, to make any change in him. But as soon as he was settled at

Munich, a change began in his mind, his thought, and even his body; and when he left Munich, three years later, on the fourth of December, 1830, he was entirely a German; so much so, that his Swiss friends had some difficulty in getting acquainted with him again. It was his first transformation; several others succeeded, as we shall see by and by.

Munich was then the most celebrated university in Germany, counting among its professors such men as Oken, Martius, and Döllinger. It was at the house of Döllinger that the three friends found lodging; occupying rooms which soon became laboratories, lecture rooms, and the rendezvous of many of their classmates. Agassiz afterward had occasion to give a vivid description of their student life, in his paper, "Erwiederung auf Dr. Karl Schimper's Angriffe" (Neuchâtel, November, 1842, 4to). In those days friendship reigned. Almost everything was enjoyed in common; work, pleasure, journeys, pipes, beer, purses, clothes, ideas political and philosophical, or poetical, and even literary. In fact, it was a constant, enthusiastic, intellectual life, lived at high pressure, lacking in nothing; not even student duels, and escapades of a more riotous nature, after grand "Kommers."

Agassiz enjoyed among the students the reputation of being the best fencer in the various students' clubs. The reputation was gained in this way: When at Heidelberg, an insult to the Swiss clan (Burschenschaft) of which Agassiz was the president was considered so serious among the students, that a challenge was sent by Agassiz to the German club. At a meeting of the

German students, a choice was made of one of their best swordsmen to meet him. Agassiz, however, would not accept such conditions, but said proudly, "It is not with one of you that I want to fight, but with all, one after another." They marched to the chosen ground, and in a few minutes four German students had received sword cuts on their faces; then the others who were to follow began to think that the affair had gone far enough, and although invited by Agassiz to take position, they offered honourable peace, and made an apology. After that, Agassiz was always chosen as arbitrator and judge at all the fencing clubs of the universities of Heidelberg and Munich. He was so carried away by his pleasure in fencing, that one day, without remembering to put on masks, he and his future brother-in-law, Alexander Braun, fell in with rapiers in hand, and after a few exchanges of thrusts, Agassiz made a cut in the face of his dear friend. Years after, when a professor at Neuchâtel, he appeared at a public fencing exhibition given by a tall and powerful negro fencing master, with success and credit.

Schimper, who was the oldest of the three, and whose imagination was the keenest and most original, exerted a great influence over Agassiz and Braun. His discoveries in regard to the morphology of plants gave him great advantage over the two others, who had not yet done any original work. But Agassiz was not the man to be long overshadowed by any one. He wanted to occupy the first place everywhere. Happily he escaped the danger to which Schimper succumbed, and, with the help of Braun, whose mind was the best balanced

of the three friends, Agassiz kept out of temptation, and expended his impetuous nature in solid and difficult work on fishes, living and fossil.

Strange to say, with an allowance of only $250 a year, Agassiz managed constantly to keep in his pay an artist, Dinkel, to draw fossil and living fishes; and, occasionally, a second artist, Mr. J. C. Weber, to draw the Spix fishes and pieces of anatomy. They formed a sort of fraternal association. As Agassiz said, "They were even poorer than I, and so we managed to get along together." Their fare was certainly very simple; bread, cheese, beer, and tobacco being the main articles. Imagine Agassiz, with his scanty allowance, providing for two artists, besides Karl Schimper, and his younger brother, William Schimper. To be sure, Alexander Braun helped much also. But if we suppose that Braun got $300 a year from his father, six young men between the ages of twenty and twenty-five had to live upon less than $600 a year, out of which also they had to pay for their studies at the university, and provide themselves with instruments, and books, and clothing. Agassiz got a little money from the "Brazilian Fishes" and some other writing, with which he purchased a microscope — a rather expensive instrument — and several books; and he received, as a gift from Professor Döllinger, a copy of the finely illustrated work on living fishes, by the great French ichthyologist, Rondelet, of Montpellier. The editor Cotta sent him also a certain number of expensive natural history books.

"I cannot review my Munich life without great grati-

tude," Agassiz says. He was there a most happy and successful young man, using all the scientific resources existing in that large and progressive city; drawing round him comrades of the University, and even professors; and receiving visits from naturalists of renown, including the great anatomist Meckel. His room in the house of Döllinger, being the largest, was used as lecture room, assembly room, laboratory, and museum. Some one was always coming or going; the half-dozen chairs were covered with books, piled one upon another, hardly one being left for use, and visitors were frequently obliged to remove books and put them on the floor; the bed, also, was used as a seat, and as a receptacle for specimens, drawings, and papers. According to Agassiz, the tobacco smoke was sometimes so thick it might have been cut with a knife.

Agassiz was the most prominent among the students. His acquaintance was courted by all. He was specially considered with much pride by all the Swiss students, and was welcome both in the rooms and yards of the University, and at the students' clubs, "Bierbrauerei," and fencing rooms. He was considered a most amiable companion, never losing his temper, always smiling and apparently contented and happy. It is no wonder that he remembered so vividly his student life at Munich, and was always grateful for it. Although at Munich he learned embryology from Döllinger, who gave him personal instructions in the use of the microscope, and followed the lectures of the great philosopher Schelling, as well as the fascinating teaching of Oken, with his *a priori* conceptions of the relations of the three king-

doms into which he divided all living beings; he was not instructed then either in palæontology or in geology, the two branches of science in which he became afterward preëminent. The only teacher he ever had in those two sciences was Professor H. G. Bronn at Heidelberg, a rather second-rate palæontologist, but a very industrious and prolific writer.

Although Agassiz came to Munich for the special purpose of taking the degree of doctor of medicine, his studies soon drifted from those of a medical student to those of a true naturalist. This change was not made without warnings from his father, who became alarmed by the rather large expenses incurred by his son,[1] and more so by his neglect of his medical studies. But Louis Agassiz was born a naturalist, and a naturalist he must be; and, notwithstanding all sorts of difficulties, with the help of his mother, who always favoured his desires, he carried through his scheme of seeking a professorship of natural history.

His first step, in regard to graduation, was to secure not a title of medical doctor and surgeon, but of doctor of philosophy, which he won, in the spring of 1829, at the University of Erlangen. The excuse for so doing was a

[1] Agassiz's good heart had already, when at Heidelberg, led him to help, pecuniarily, Karl Schimper, and as soon as established at Munich, he sent Schimper money to pay the expense of his journey, and invited him to join them in their lodging. Schimper not only came directly, but brought with him his brother William. Agassiz's income was henceforth, on this account, limited in proportion. It must now suffice for the maintenance of a friend; for as soon as Schimper arrived, Agassiz gave him the key of his chest in which was his money; and, during the three years of his stay at Munich, he, in fact, gave to Schimper the means to satisfy all his needs — a rare example of generosity.

clever one. Martius had proposed to him to publish the fishes of Brazil collected by Spix and himself during their explorations on the Amazon, from 1817 to 1821. Spix having died in 1826, before finishing the publication of the zoölogical part, Martius, who possessed excellent judgment and great insight into character, saw at once the ability of young Agassiz as a describer of species, and proposed to him, during the summer of 1828, to take the fishes. The offer was certainly most flattering to Agassiz, then in his twenty-first year, and before he had yet published anything to recommend him. Martius assumed all the expenses and, of course, all the profits; and Agassiz received as his share only a few copies of the book, with an atlas of beautifully coloured fishes. Before the book was issued, Martius told him that it was important that his name should have the title of doctor of philosophy attached to it, and that at the same time it would help him to get a professorship of natural history.

However, that title would not do as a substitute for his medical degree, and, bracing his courage, he worked hard, and prepared his theses with great success; for when he received his degree of doctor of medicine and surgery, the 3d of April, 1830, the dean said to him: "The faculty have been very much pleased with your answers; they congratulate themselves on being able to give the diploma to a young man who has already acquired so honourable a reputation." It was nine months after the publication of his great work on the fishes of Brazil, a folio with ninety plates, which had attracted the attention of all naturalists, more especially

of George Cuvier, the greatest ichthyologist of his time, who was then engaged on his celebrated work "Histoire des Poissons." Agassiz's work, which was dedicated to Cuvier, is written in Latin, and possesses the qualities so prominent in all Agassiz's publications; namely, accurate descriptions of the species, and excellent and even beautiful figures. It is most creditable in every way, and it furnished a sound basis for Agassiz's reputation as an ichthyologist of the first rank, although he was only twenty-two years old.

This first success was much enjoyed by his family and his friends, and prompted him to undertake a task which was sure to place him in the front rank as a naturalist, "hors ligne." Soon after the vacation of 1829, which was spent at Heidelberg, Carlsruhe, and Orbe, the director of the museum at Munich offered to Agassiz every facility to work at the collection of fossil fishes, allowing him to carry the specimens to his room. As the director of the Strasbourg Museum, the mining engineer Voltz, and Professor Bronn of Heidelberg had made the same offer, Agassiz, seeing what a splendid work was laid before him, did not hesitate to undertake it, notwithstanding the great difficulties, both material and scientific.

A few words should be said in regard to his method of undertaking work without being sure beforehand of the means to carry it on successfully. For example, in the case of his "Poissons fossiles," as we shall see, he first tried a M. Cotta, a publisher of Stuttgart, and when the latter failed to come to a final agreement for want of knowledge as to his part of the

expense to be incurred (for Agassiz never knew beforehand what his work would be, even approximately, as to quantity of text and plates), he found that he could rely upon no one, but must himself publish his rather expensive work. Martius's work on Brazil was aided by a large subscription from the purse of the king of Bavaria. The only country in which it was possible to find a publisher for a very expensive work on natural history was France; and even there publishers required a certain number of subscriptions from the government before accepting the charge. "The Mineral Conchology of Great Britain" had involved great expense, without proper return, and was anything but a success in a pecuniary way. Goldfuss's "Petrefacta Germania," then in course of publication, 1826–44, was supported only by the personal sacrifice of the author himself. Even Cuvier's great work on the "ossements fossiles" was not successful from a bookseller's point of view, and without the help of the French government it would have been impossible to publish it.

If Agassiz had been a business man, or a good manager, he might have succeeded in having his work on the fossil fishes published in Paris, with a sufficient subscription from the Secretary of Public Instruction to carry on the work, if not at a profit, at least without loss on his part; for Cuvier was then publishing his "Histoire Naturelle des Poissons" in that way; and if that great work, finished after the death of Cuvier by Valenciennes, was not a pecuniary success, it entailed at least no expense upon its two authors.

Agassiz always acted as if he were a very rich man;

and now, taking an excellent artist, Joseph Dinkel, into his service, he had him draw all the fossil fishes he could find in the different museums; and, full of hope and never thinking of the morrow, he began his "Poissons fossiles," trusting to good luck and his power of persuasion. He was not patient enough to wait for the proper moment. With him time was money, and he pushed forward without regard to consequences. He had such self-confidence that it is almost amusing to see him writing to his father from Munich, Feb. 14, 1829: "I wish it may be said of Louis Agassiz that he was the first naturalist of his time, a good citizen, and a good son, beloved by those who knew him. I feel within myself the strength of a whole generation to work toward this end, and I will reach it if the means are not wanting." Strange to say, he attained his aim; if not the first, he was certainly one of the first naturalists of the nineteenth century; he was a good citizen of Switzerland and afterward of the United States, a devoted son to his father and mother, and beloved, if not by all, certainly by a great many of those who knew him in Europe and in America. This intuition of his capacity and strength, this thought that he had concentrated in him the powers of all his ancestors to observe and work on natural history, is something almost wonderful in its *naïveté*. It is not strange that his father was often frightened for the future of such a prodigy, for such certainly Louis Agassiz was.

During his stay in Munich, he went home only once, spending there the two months of October and November, 1829. His time was passed mainly at the parson-

age of Orbe, and at Cudrefin, near his good grandfather, Dr. Mayor, who died during Louis's visit. As soon as he returned to Munich in December, 1829, he began his great work on the "Poissons fossiles," pursuing at the same time his medical studies, and, as we have seen, successfully passing his examinations, the subjects being anatomical, pathological, surgical, obstetrical, with inquiries into "materia medica," "medica forensis," and the relation of botany to these topics, as it is printed in his "Einladung."

As soon as his examination and the ceremony of receiving the degree from the rector of the University were over, he started for Vienna, where he passed almost two months. It was a great gratification to him to find that his reputation had reached Vienna, for he was received there, by professors and curators of museums, as "an associate already known." He looked specially at fossil fishes, and made memoranda of all the specimens, to be used afterward in his great work. His memory was so good, his eye so accurate, that many years afterward, when looking at fossil fishes at Neuchâtel, he one day said: "I have seen before another specimen of this same species in the museum at Vienna"; even going so far as to indicate the drawer in which it was stored. The director at Vienna, on being written in regard to it, answered that he had found the fossil fish where Agassiz had indicated that it was, and sent it at once. It was, as Agassiz said, of the same species.

Agassiz's last letter from Munich to his parents is dated Nov. 26, 1830. He left Munich the 4th of De-

cember, 1830, after settling all his accounts and expenditures, taking with him his draughtsman, Dinkel, to the great amazement of his father, who did not relish the arrival of his son's friend at his new parsonage at Concise, whither he had just removed from Orbe. His protest, that there was no room for another person, was of no avail. Louis wrote him that Dinkel was not in his pay, but was provided for by his publisher, M. Cotta, and that an agreement had been made for him to accompany Agassiz in future wherever he should go. Accordingly, one morning in December, 1830, he arrived with Dinkel, who was lodged in the neighbourhood, and came every day to Louis's room to draw fishes.

The parsonage of the village of Concise is beautifully situated close to the north of the church, with a terrace and garden overlooking the Lake of Neuchâtel, and commanding some of the most beautiful and extensive scenery in Switzerland. The room occupied by Louis Agassiz was on the first story, according to the way of counting stories in Switzerland; the second story, according to the American way, at the southeast corner of the parsonage, close by the churchyard. There he was seen constantly at the window, with his long moustaches, smoking, and hard at work with specimens.

The arrival of the parson's son, with his draughtsman, both dressed more or less as German students, with small caps on their heads, and long pipes in their mouths, greatly excited the curiosity of the quiet villagers. On Sunday they used to row on the lake, and, with long poles, passed their time in breaking the pot-

tery jars, easily seen at the bottom through the transparent blue water, an amusement the young men of Concise were somewhat addicted to. How little Agassiz then thought that he was doing the work of a true barbarian, destroying pottery utensils which had belonged to his ancestors, the lake-dwellers of prehistoric time! After the discoveries of Keller at the Zürich Lake, Agassiz, remembering what he did in 1831 on the Lake of Neuchâtel, exclaimed: "How foolish I was! Dinkel and I have in sport broken dozens of important prehistoric pieces of pottery."

Almost a year of good work was passed at home, with nothing to disturb him, writing his "Poissons fossiles" and directing Dinkel's drawings. It was a great change after his rather boisterous student life at Munich. His habitual audience of fifteen or twenty persons, meeting daily in his room, and called the "Little Academy" by common consent, by both students and professors, was now reduced to Dinkel and his own family circle, with a few friends, relatives, and old acquaintances, who came in now and then, and were rather surprised, but unable to appreciate the work in which Louis was so deeply engaged.

Finally, the attraction of Paris proved too great, and to Paris he resolved to go, — a determination which he found not easy to carry into effect.

He had exhausted the paternal purse, and money was difficult to secure. At this critical moment came assistance, which was prompted entirely by friendly admiration and confidence in his future. An old friend of his father, a pastor of the Canton de Vaud, M.

Christinat, who had always been very fond of Louis since his childhood, came one day and simply put in his hand a sum of money sufficient for a journey to Paris. Helped also by his uncle Mayor of Neuchâtel, and his publisher Cotta, he was able to start on his much-desired journey to see Cuvier and enlarge his field of study of "poissons fossiles" in the great collections of Paris. Agassiz never forgot the generosity of Christinat, and after the death of his father he always considered Christinat a second father, feeling for him a true filial love.

He took "le chemin des écoliers" for Paris, passing by Stuttgart, Carlsruhe, Heidelberg, and Strasbourg, "to collect," as he says, "for my fossil fishes all the material I still desired, and to extend my knowledge of geology sufficiently to join, without embarrassment at least, in conversation upon the more recent researches in that department." To be sure, he took with him his draughtsman Dinkel; but the "zigzag" journey was made mainly in order to see the Braun family, and more especially Miss Cecilia and his dear classmate and friend, Alexander Braun, the best companion of his student life. Braun was the most reasonable by far of the trio, Agassiz, Braun, and Schimper; he was also the most steady and persevering as a student. His knowledge of geology was far superior to the knowledge of Agassiz in that branch of natural history; and Agassiz's avowed desire, as it were, to interview Alexander Braun on recent researches shows the method constantly used afterward by him for learning and keeping himself informed as to the progress and condition

of geology. During all his stay in America, I was interviewed on my return from trips to Europe, or the interior part of the United States and Canada. Agassiz, with his remarkable memory, his keen perceptions of new discoveries, and his easy way of marshalling facts and using them afterward in his lectures or papers, would ply me with questions during two or three hours, in regard to all I had learned during my absence from Cambridge. It was a peculiar and rather original way of learning the more recent researches and the history of the progress of geology. But to make use of the facts without too much blundering required the splendid and rare qualities of an Agassiz.

In the letter to his mother, dated Carlsruhe, November, 1831, in which he speaks of his visit to the Brauns, he says: "I have added to my work on the fossil fishes one hundred and seventy-one pages of manuscript in French, written between my excursions and in the midst of other occupations." It is to be regretted that, with such facility as a scientific writer, he gave up almost all writing after 1837, trusting to secretaries, assistants, and stenographers.

CHAPTER III.

1831–1832.

First Visit to Paris — His Relations with Cuvier — Humboldt charmed with Him — His Visit to the Seashore at Dieppe — Death of Cuvier — Sketch of Cuvier's Life — Cuvier and Geoffroy St. Hilaire — Their Discussion before the French Academy of Science — Cuvier's Influence on Agassiz — Difficulty of getting an Official Position in Paris — Appointed Professor at the Lyceum of Neuchâtel.

On the 16th of December, 1831, after travelling by diligence for two days and three nights, on the road between Strasbourg and Paris, Agassiz and Dinkel alighted in the great crowded courtyard of the "Messageries Royales," rue Montmartre, so tired that they could hardly move hand or foot. The fatigue of these long journeys, in diligences, can hardly be realized now.

Packed in the rotunda with six often disagreeable neighbours, all breathing the same foul air, and jostled and even severely shaken from the bad roads, over which the diligence had to run, it was a great relief, first when the paved roads were reached, eighty miles before the arrival in Paris, and later when the great stagecoach finally turned into the courtyard of the "Messageries." It was an interesting sight for Agassiz to watch the diligences, arriving or starting, with promi-

nent names, such as Forback, Bruxelles, Dunkerque, Calais, le Havre, Cherbourg, Brest, Nantes, Bordeaux, Bayonne, Toulouse, Perpignan, Montpellier, Marseilles, Lyon, Besançon, etc. Nearly every tongue was heard there, and the weary look of the arriving passengers was something not to be forgotten. He had not seen anything approaching the scene in Southern Germany, or even in Vienna. However, he soon found his way to the rue Copau, on the other side of the Seine, and alighted finally at the "Hôtel du Jardin du Roi," No. 4, just opposite the "Hospital de la Pitié," and close by the Jardin des Plantes. This third-rate hotel has always been a place of resort for naturalists, — French as well as foreign, — on account of its proximity to the great Museum of Natural History. The prices there were moderate and the fare good; a part of the old hotel, and the most desirable, was situated between a paved yard and a garden. It was here that Agassiz and Dinkel got a room. Sixteen years later, I saw Agassiz occupying the same room, quite proud to show that nothing had been changed in the arrangement of the furniture. There were the same shelves for books, where he placed, as he told me, the first works offered to him by both Cuvier and Humboldt; the only alteration being the removal of the small bedstead on which Dinkel slept.

As soon as Cuvier heard of his arrival, he sent for him; and Agassiz passed his second evening in Paris at the house of the great French naturalist. His reception was cordial and friendly, although with some reserve; for Cuvier was not a man of many words. His

politeness was dignified, his manner that of a courtier accustomed to move among men in high office or of great social position. But he was kindly disposed and good hearted, his most notable characteristic being a kindliness directed right to the point, in order that no time might be lost. He always acted as if every hour was extremely valuable to him, working methodically; each day, each hour, having its task appointed in advance, and he was reluctant to be interrupted or interfered with in the course of his researches or thoughts. The first meeting was more than satisfactory to Agassiz, who had not expected such a friendly reception, which, in his own words, "more than fulfilled his expectations." He was absolutely astounded by the great erudition, the prodigious memory, and the extreme facility of Cuvier in passing from one arduous subject to another. Agassiz was more than charmed; he was actually astonished by the immense amount of knowledge accumulated in the brain of a single man. This first impression was never changed; and the more he knew of Cuvier, the more he admired him. Agassiz had found his master, and his leader for life.

After a few days of intercourse, Cuvier was so satisfied with the author of the Brazilian fishes that he gave him and his artist a corner in one of his laboratories, — the one devoted to fishes; for Cuvier possessed a laboratory for each of his works, where was accumulated everything pertaining to the subject, such as specimens, drawings, and books, in order not to lose time. The arrangement was a matter of wonder to Agassiz, who

tried afterward — always in vain — to secure the same orderliness for himself. But later I shall give the reason why Cuvier was able to organize his time and laboratories, and why Agassiz always failed to do so.

Agassiz's main object in coming to Paris was to collect material for his "Poissons fossiles," and at the same time to become acquainted with Cuvier and some other French naturalists, in the hope that he might find an official position in such a great establishment as the Jardin des Plantes. Cuvier watched him attentively, and was so pleased with what he saw, that he deliberately decided to renounce his project of publishing, as he had intended, a work on fossil fishes; and with great generosity — too rare among savants — he placed at the disposal of young Agassiz all the materials, drawings, and notes which he had collected at the British Museum, at Avignon, and elsewhere, during more than fifteen years.

It was at one of his weekly Saturday evening receptions that Cuvier delivered into Agassiz's hands the drawings and notes, filling a large portfolio, brought from the study by his faithful assistant Laurillard. It filled Agassiz with greater joy than he had ever felt before or than he ever felt again, as he said many years after. Certainly such an acknowledgment from the greatest naturalist then living was a most gratifying and unexpected reward for all Agassiz's studies and efforts. It was most encouraging and auspicious for his future. All that Agassiz had expected, and even this was with grave doubts, was that, perhaps, Cuvier might be induced to allow him to assist in finishing the work with

him, just as he had lately allowed Valenciennes to help him to finish his "Histoire naturelle des Poissons vivants." Of course the gift of Cuvier was highly appreciated by his parents on the shore of the Lake of Neuchâtel. It was most gratifying for them to see their dear Louis so well treated. But, alas! just at this time the small sum of money he had brought with him began to run very low; and there was no immediate prospect of replenishing his purse unless he accepted an offer from J. Daudebard de Férussac to take the editorship of the zoölogical part of his "Bulletin des annonces et des nouvelles scientifiques," which would yield an additional thousand francs a year, but would require two or three hours' work daily.

One of his first acquaintances at Paris was Alexander von Humboldt, then a star of the first magnitude among the numerous great French savants. If Cuvier's welcome was somewhat reserved and marked by formal politeness, lacking cordiality, Humboldt's reception took a form of indulgence and kindness which warmed Agassiz's heart. From their first meeting at the apartments of Humboldt, in his working room in the rue de la Harpe in the Latin Quarter, a mutual attraction was felt; and the terrible Humboldt, the fear of all savants and of all the great salons of Paris, took a fancy to the young Swiss naturalist. He took him to breakfast at his usual café-restaurant, the celebrated Café Procop, rue de l'Ancienne Comédie, near by; and there, as was his custom, hardly taking time to eat, he talked incessantly of his experience among the electric fishes in Venezuela. Agassiz, who was all attention, did not

interrupt him once, — certainly a great mark of admiration on the part of Agassiz, who was himself a great talker, — and after three hours together, they separated at the door of the Mazarine Library, charmed with each other.

To have pleased a man so sarcastic as Humboldt was not a small triumph. He was conquered by the juvenile enthusiasm, the extraordinary optimism, of Agassiz. As one of the friends of Agassiz says, "Lui (de Humboldt) qui était si mordant de nature n'est qu'affectueux et plein de sollicitude en écrivant ou en causant avec son jeune ami."

In some way Humboldt learned through the publisher, Cotta of Stuttgart, the straitened circumstances under which Agassiz was labouring, and therefore simply enclosed in a letter a "billet de la Banque de France" for one thousand francs, begging him to accept it. Agassiz, in his letter of thanks, dated the 27th of March, 1832, calls Humboldt his "benefactor and friend," and confesses that his kind and helpful hand has unexpectedly rescued him from a distressing position, and that now he is again in hope of devoting his whole powers to science. Humboldt was then minister plenipotentiary of Prussia to the court of the Tuileries; and his timely help won for him an admiration which ended only with the last day of Agassiz's life. As Agassiz himself says, "I was pleased to remain a debtor of Humboldt, for I have never returned the sum he bestowed at such an opportune moment."

Agassiz-like, as soon as he was recovered from his despondency in regard to money, his buoyant spirit led

him at once on a journey to the seashore of Normandy in company with Alexander Braun, who had joined him in Paris six weeks after his arrival, and Dinkel. They walked all the way from Havre to Dieppe, enjoying to the full the spectacle, so new to them, of living sea-animals, bringing back from that too short visit many new ideas, cheered and stimulated by "the great phenomena presented by the ocean in its vast expanse."

A few weeks after his return from Normandy, Agassiz sustained a great loss, — a loss which affected the rest of his life, — in the death of his master, George Cuvier. Since Carnival and during the whole spring cholera had been raging fearfully in Paris, greatly increasing the death rate; some quarters, however, like the Jardin des Plantes, had been almost free from the terrible scourge, but there it at last made its appearance, and one of its most illustrious victims was Cuvier. Sunday, the 6th of May, 1832, Agassiz, as was his custom, worked all the day until dinner time at five o'clock in Cuvier's study. During a conversation, Cuvier, seeing how intense Agassiz's application to work was, said to him: "Soyez prudent, et rappelez vous que trop de travail tue." On the next day Baron Cuvier, who, in 1831, had been created by King Louis Philippe a peer of France, when about to ascend the tribune in the Chamber of Peers, at the Palace of the Luxembourg, to deliver an address, suffered paralysis. He was carried home, and rallied, but died on Sunday, May 13, 1832, the immediate cause of his death being an attack of cholera.

The unexpected and somewhat premature death of

Cuvier at the age of sixty-three — for his life might have extended ten and perhaps fifteen years longer — had a very serious effect, which cannot be overestimated, on the future of Agassiz. Cuvier was the only man who exerted a scientific and personal influence over Agassiz; from him, and him alone, Agassiz would accept advice, and be guided in his work. He recognized in him his master, and the young charmer of Switzerland found in him another more powerful than himself, and especially more practical in his life and work. At first the formal politeness of Cuvier chilled him, and he says, "I would gladly go away were I not held fast by the wealth of material of which I can avail myself for instruction." But this first impression soon passed away, and an unbounded admiration replaced it.

Some details are necessary to understand the course taken by Agassiz, and the singular resolve to leave Paris, at that time the Mecca of all naturalists and savants, to settle as a professor, with a very small salary, in a small town of less than six thousand inhabitants, in a hybrid country, half Swiss, half Prussian, lost in Central Europe.

Cuvier, son of an officer of a Swiss regiment, in the French service, and nephew of a Protestant clergyman of talent, was called to Paris, after the revolution of the 9th Thermidor, by young Geoffroy, — celebrated since as Etienne Geoffroy Saint-Hilaire, — and attached to the Jardin des Plantes, as substitute for the professor of comparative anatomy. The reading of some manuscript papers on natural history, sent by Cuvier, had

excited in the enthusiastic mind of Geoffroy such an admiration that he wrote him, then in Normandy, acting as tutor in a nobleman's family, "Come and play among us the part of Linnæus — of another legislator and ruler of natural history." This was at the beginning of 1795. Cuvier soon rose to the front rank, and even to so high a position that, after 1817, the year of the appearance of his "Règne animal," he was recognized by all European naturalists as unquestionably the leader. From that moment Cuvier developed a love of power and a tyrannical spirit which surprised and grieved some of his best friends. He became overbearing and impatient of any opposition to such a degree that in 1830, during the celebrated discussion before the French Academy of Science, occasioned by the publication of the "Principes de philosophie zoologique," in May, 1830, a rupture occurred with his lifelong friend Geoffroy Saint-Hilaire. Cuvier and Geoffroy became irreconcilable antagonists, but remained personally friendly, though the intimacy which had existed between them during more than thirty years ceased, as much through the fault of Geoffroy as of Cuvier. In the discussion Geoffroy was very overbearing, and assumed a rôle which extremely irritated Cuvier. It is generally admitted now that Cuvier went too far, although he refuted, with a surprising number of facts, the arguments presented by Geoffroy on the six great problems: (1) The pre-existence in natural history of the genus; (2) the unity of organic composition; (3) the value of classification; (4) the fixity of species; (5) the final cause; and (6) the succession of organic

life on earth. Thanks to his genius and his unrivalled talent of exposition, Cuvier won before the Academy; but it was plain that the general public was against him and in favour of Geoffroy. During the last two years of Cuvier's life the discussion was continued, not before the Academy, but in public lectures at the College de France. Cuvier, with renewed vigour, assailed the unity of organic composition and any general conception in natural history. As Isidore Geoffroy says: "Disciple, Cuvier ne pouvait l'être de personne, et par les tendances propres de son esprit, moins de Geoffroy Saint-Hilaire que de tout autre; il devint donc adversaire." We may say, to the credit of Geoffroy, that his admiration of Cuvier was not diminished, and at his tomb, with great emotion, and in words of sincerity which had their source in his heart, he proclaimed him "le Maître à tous!"

Agassiz felt strongly the influence of Cuvier; he had repeated occasion to see and compare Cuvier and Geoffroy, and the superiority of Cuvier was so undeniable, that many years afterward, when the question of fixity of species, descent, and succession of forms again arose with Darwin's "Origin of Species," he did not hesitate for one moment to oppose a doctrine so full of hypothesis and so contrary to the teachings of his master: "le Maître à tous!" Agassiz had promptly received the good will and protection of Cuvier, and it is most probable that, if Cuvier's life had been spared, he would have obtained, through his influence, a professorship or some place in Paris. For Agassiz was determined not to be a country physician, but to support himself

as a naturalist. It is always very difficult in Paris to get a scientific position, on account of the great number of aspirants always waiting for a favouring opportunity. After a few months, Agassiz soon realized his superiority over all the young and even old naturalists, and acknowledged only one master, — George Cuvier! For Agassiz was not naturally self-distrustful; he knew his worth, and it was rather humiliating to him to be placed beneath certain savants whose merits and capacities were far below his. He had to reckon with those who held what is called in Paris "positions acquises," that is to say, with savants who had been gradually promoted from very modest places to higher positions. Cuvier's death left vacant a large number of places, and a regular scramble to occupy all the positions he had held began in earnest as soon as he was buried. Not being a Frenchman by birth, Agassiz was at a disadvantage; although an Englishman, Henri Milne-Edwards had the good fortune to push himself forward, and finally succeeded Cuvier. But Edwards, who was older than Agassiz by several years, had been educated in Paris, and knew how to make use of influence. He made loud claims to being a Frenchman born, because he was accidentally born in Bruges in Belgium during the occupation of that country by the armies of the French Republic. Another competitor was Valenciennes, also older than Agassiz, and an assistant of Cuvier, who had begun with Cuvier the publication of the "Histoire naturelle des Poissons vivants." To be sure, the publisher of the work proposed to Agassiz to join Valenciennes as a collaborator; but Humboldt,

who had always taken a strong interest in Valenciennes' welfare, rather discouraged the association, knowing well that Agassiz would soon extinguish all Valenciennes' future prospects. Humboldt exerted a strong influence over Agassiz. As minister of Prussia in France, he cunningly worked to detach Agassiz from Paris, increasing rather than diminishing the obstacles and difficulties Agassiz found there, acting in accord with the Prussian governor at Neuchâtel, and M. Louis de Coulon, a rich and most benevolent Neuchâtelois, who wished in some way to attach Agassiz to the Lyceum of Neuchâtel. After the death of Cuvier, Agassiz, with his independent character, was discouraged and distressed by the constant intrigues going on under his eyes in restless Paris. On the other hand, he was still mindful of his happy days in Germany, and desired to return there as a professor in some German university.

Humboldt, little by little, persuaded Agassiz to accept a very modest — altogether too modest — position as professor at the Lyceum of Neuchâtel as a stepping-stone and a preliminary position to a professorship at Berlin or some other German university. Agassiz hesitated, for he knew very well that Neuchâtel was too small a place, and devoid of all resources in natural history; and his thought was at first to settle at Lausanne, or preferably at Geneva, then already a great scientific centre. But Humboldt and Coulon united their efforts, and at last secured the acceptance of Agassiz, who, in September, 1832, left Paris, to the great joy of all the young French naturalists of the capital; for he was a formidable rival taken out of the way.

Agassiz always disliked intrigue; he was frank and very earnest, and, although inclined to authority and adverse to divided power, he was too little French, or more correctly too little Parisian, in character, to like living in a society in which intrigue was as necessary as scientific knowledge to success. He had too high an opinion of science to make compromises and constantly bargain for position, influence, and honour.

With the death of Cuvier vanished all his hopes of a great journey beyond Europe, — a desire which had pursued him ever since he began the study of natural history at Zürich with Schink. What he heard in Paris of the great success of Victor Jacquemont in India, and of Alcide d'Orbigny in South America, had increased tenfold his wish to be a travelling naturalist, and the long account given to him by Humboldt of the equinoctial regions of the New World increased, if possible, his cherished determination to make an exploring journey. Cuvier had told him that after the return of Jacquemont and d'Orbigny, then daily expected, the annual appropriation at the disposal of the Museum would be in part free, and might be bestowed on him. His dreams of seeing the great Amazon River were revived, but were not destined to be realized till more than thirty years afterward, under other auspices, and under much more fortunate conditions.

If Agassiz had been able to make a great exploration into the interior of a continent, or around the world, when he was between twenty-five and thirty-five years of age, what a harvest of facts he would have brought back with him! It is much to be regretted, both for

himself and for the progress of natural history, that he did not enjoy that privilege.

It is useless to express regret as we see him burying himself in such a remote place; for wherever Agassiz went he carried with him the torch of science, and obliged all the scientific world to look at him and give close attention to what he said and did.

CHAPTER IV.

1832–1835.

Agassiz's First Establishment at Neuchâtel — Foundation of the "Société des Sciences Naturelles," on the 6th of December, 1832 — An Offer of a Chair at the University of Heidelberg declined — Letter of Humboldt — Engagement of Alexander Braun with Miss Cecile Guyot and that of Karl Schimper with Miss Emmy Braun broken off — Marriage of Agassiz with Miss Cecile Braun — Publication of the First Part of the "Fossil Fishes" — First Visit to England in 1834 — "Monographie des Echinodermes" — Des Moulins's Work on the Same Subject — Criticisms of Humboldt and Von Buch — Second Visit to England in 1835 — Birth of a Son — Four Letters to Pictet and Nicolet.

In November, 1832, Agassiz was established at Neuchâtel as professor of natural history in a small college, at a salary of eighty louis (about $400), and with an appointment of only three years' duration. What tempted him greatly was the opportunity to live in Switzerland, near his family, complete independence in regard to his teaching, and a belief that, notwithstanding the small salary, the expenses of living were so much less than in large cities like Paris or Munich, that $400, or 2000 francs, would "keep him above actual embarrassment." Independence he got; and independence was a strong trait in his character, and one which explains several of his otherwise rather peculiar deci-

sions at different periods of his life. But insufficiency of means, resulting from his want of business capacity, assailed him from the first moment of his arrival in Neuchâtel. As to its being a stepping-stone to a position at Berlin, that expectation was never realized; all prospects in that direction having been entirely barred, as we shall see, by the part he took in the glacial question five years later.

A college in a small town of five or six thousand inhabitants, like Neuchâtel in 1832, and after the political and very grave disturbances which occurred there in 1831, as a consequence of the French Revolution of July, 1830, was, of necessity, a very limited institution. The number of pupils, all told, was below one hundred; and there were absolutely no materials for study, no collections, not even a room to be used for the new class. Agassiz was obliged to deliver his lectures at the City Hall, in the room of the tribunal of the justice of the peace. With his impetuous and optimistic spirit and his impulsive nature, he went to work, and, without losing a minute, he undertook to form a centre of scientific culture with the rather scanty and rough material at his disposal. With the help of the two Louis de Coulons, father and son, — two of the most devoted, and, at the same time, most modest naturalists, — Agassiz arranged a provisional museum in the Orphans' Home, bringing there the already numerous specimens of natural history collected by himself in Germany, Switzerland, and France.

Less than a month after his arrival and the delivery of his inaugural lecture, "Upon the Relations

between the Different Branches of Natural History," which was given on Nov. 12, before all the educated and intelligent men Neuchâtel could assemble, his father included, — on the 6th of December, 1832, he founded the "Société des Sciences Naturelles de Neuchâtel," in the parlour of M. Louis de Coulon, Sr., who was elected president, while Agassiz was made secretary. During the first six years of its existence the society met at M. de Coulon's private house. It was rather more a scientific club than a true society, meeting twice a month from November until May, and monthly only during the rest of the year. The annual subscription was moderately placed at three francs (sixty cents). Only six persons founded the society, — Agassiz, Auguste de Montmollin, the geologist, Louis de Coulon, Jr., and three others. At the end of the first three years of its existence, the number of fellows was only twenty-five, and not more than six or eight members were often present at the meetings. Agassiz was the leading spirit; and he wrote the proceedings of the sections of natural history and medical science for the years 1833, 1834, 1835, and 1836. His first contribution was a "General Report on the Progress of Natural History during the Last Few Years," in which he paid a tribute of admiration to George Cuvier, and at the same time lamented the recent death of "Ce héros de la science"; and declared that the only way to success is by "the conscientious observation of nature."

Not satisfied with delivering a course to his class at the college, he gathered round him a select and limited

audience of persons desirous to hear him on zoölogy, botany, and the philosophy of nature. And when the weather permitted, he used to take all his pupils, young and old, on excursions into the field; visiting, among other places, the celebrated quarries of the Neocomian at Hauterive, the summit of the Chaumont Mountain, and the shores of the lake. It was a spectacle worth seeing. One of those who enjoyed these excursions said to me: "Agassiz was at his best, passing from a plant to a fossil; from physical geography to a fish, a snail, a bird, an insect, anything that came in his way; always ready to discourse for hours, and, as usual, full of all sorts of new schemes. Time passed only too quickly in his company."

Everything then seemed to smile on him; it was a sort of triumphal entry into life. A few days after his installation at Neuchâtel, he received, on the 4th of December, 1832, a proposal to present himself, if he wished, in place of Professor Leuckart, at the University of Heidelberg, which he declined to do. He consulted Humboldt about the call from Heidelberg, in a letter published by Mrs. Agassiz, Vol. I., pp. 213–217; but as Mrs. Agassiz was unable to give Humboldt's answer, I will give it in full in French, translated from the German by Agassiz himself for his uncle Mayor.

BERLIN, 29 décembre, 1832.

LETTRE D'ALEXANDRE DE HUMBOLDT À LOUIS AGASSIZ, —

Je n'ai point d'expression, mon cher Agassiz, pour vous témoigner quel grand plaisir me procure chaque ligne que je reçois de vous, ainsi que les marques d'amitié que vous me donnez. Je ne puis excuser le retard que j'ai mis à repondre à votre dernière lettre que

par mon bras manchot et la vie pénible que je mène entre Berlin et Potsdam, où je vais retourner dans un instant et passer quelque jours avec le roi. Vous m'aimez assez pour ne pas vous en fâcher. Ceci n'est pas non plus une lettre, mais seulement une marque de ma gratitude et mon opinion sur la proposition si honorable qui vous est faite d'une chaire de professeur à Heidelberg. Je reconnais, mon cher ami, le grand sacrifice que vous ferez en refusant, mais sans pouvoir de loin apprécier votre position à Neuchâtel, et surtout ce qu'elle peut avoir de fixe, je penche cependant pour vous engager à y rester. Ce pays est en quelque sorte votre patrie ; on vous a reçu là, à ce qu'il me parait avec beaucoup d'empressement. Il est vrai que par ce choix, vous perdez sensiblement en argent, mais à Neuchâtel vous avez plus de temps à vous, et vous vivez dans une ville riche, où certainment, en considération du sacrifice que vous faites, on aidera peut-être plus qu'ailleurs, soit par reconnoissance, soit par un sentiment d'honneur ou même de vanité de vous posséder (le patriotisme prend toutes ces tournures) dans la publication de vos deux grands ouvrages qui doivent être le but essentiel de votre vie. Un homme de votre talent et de votre savoir, lorsqu'il aura publié ces deux ouvrages, sera placé si haut que de telles offres par des universités allemandes ne sauraient manquer d'être renouvelées. Il est vrai que je préférerais Heidelberg à toute autre, même à Berlin, où maintenant l'étude des sciences naturelles est assez négligée. Cependant je désirerais qu'il fut bien connu par les feuilles publiques que vous avez eu cet appel et que (sans menacer indélicatement) vous missiez à profit votre refus pour fixer votre position à Neuchâtel, pour accélérer l'achat de votre collection et pour obtenir la promesse de quelques souscriptions considérables pour vos ouvrages. Je ferai tout ce qui dépendra de moi auprès de M. Ancillon et suis bien certain de ne rencontrer ici aucun obstacle, mais je crains qu'à Neuchâtel même on ne soit un peu intimidé par une dépense de 600 louis, au moins à présent. En Allemagne, il est maintenant très difficile d'obtenir quelques cents louis d'un gouvernement pour quoique ce soit. On prétexte toujours les probabilités d'une guerre, à laquelle du reste personne ne croit. L'essentiel maintenant me paraît (et je vois avec plaisir que vous y visez con-

stamment) que vous fassiez voir au monde, même avec des figures moins soignées, ce que vous avez si admirablement bien examiné, et si vous ne pouvez pas publier en même temps ces deux ouvrages, donnez la préférence aux fossiles. Vous le pouvez d'autant mieux que vous avez si heureusement découvert les rapports qui existent entre votre classification des poissons et la succession des formations géologiques. Je suis bien impatient de la connaître dans tous ses détails. Ne négligez pas de consulter sur les fossiles en général la traduction du manuscrit de de la Bèche par Dechen; c'est lui qui, à mon avis, rend le mieux compte de l'état actuel de la géologie. C'est aussi l'opinion de de Buch.

Si vous ne pouvez pas commencer promptement la publication de votre ouvrage, il faudrait nécessairement pour ne pas être volé, publier de suite sous vos yeux un mémoire en français dans lequel vous rendriez compte de vos idées générales sur la classification des poissons, leur distribution géographique et géologique, etc. Afin que votre ouvrage produise tout l'effet qu'il doit faire, restreignez vous aux poissons et ne donnez que quelques indications générales sur les autres organismes.

Je vous embrasse tendrement, mon cher Agassiz; assurez votre bonne mère de toute mon estime.

Votre A. HUMBOLDT.

This letter is, perhaps, the most important and affectionate one from Humboldt to his young friend Agassiz.

Thanks to Humboldt's personal application to the Prussian government, and the initiative subscriptions taken by Louis de Coulon at Neuchâtel, a sufficient sum of money was obtained to purchase, for the newly created Museum of Neuchâtel, the collections of Agassiz. He received the round sum of 600 louis, or almost $3000.

With his optimism, always ready to go beyond all reasonable bounds, he thought that in coming to Neuchâtel he had made his fortune; and his first desire

was to get married. As is often the case with students, the trio, Agassiz, Braun, and Schimper, had promptly fallen in love. They were surrounded by too many young sisters and friends' sisters not to succumb. Agassiz's choice was Cecile Braun; Schimper became engaged to her older sister Emmy, and Braun himself was soon enamoured of a sister of Arnold Guyot, also called Cecile. As shown by the result, it would seem that it would have been well if the three engagements had been broken off. Alexander Braun, the most reasonable and practical of the three, had the good sense not to go too far. His regard for Cecile Guyot of Hauterive, near Neuchâtel, soon took the form of friendship. No public engagement was announced, prudence on both sides keeping the matter rather quiet, until, by common consent, Mademoiselle Cecile Guyot, instead of a "mariage d'inclination," considered by her very practical family as a great "imprudence," agreed to a "mariage de convenance" at Neuchâtel, — a "parti fort avantageux," according to Arnold Guyot, — and, instead of becoming Madame Braun, was contented to call her old sweetheart "son bon frère Alex." [1]

Although Alexander Braun was a great admirer of the botanical genius of Karl Schimper, he soon saw the weak point of his character. After waiting several years from the time of the engagement in 1832, Miss Emmy Braun realized too well the unfitness of Schimper, and, with the help of her brother, broke the engage-

[1] See "Alexander Braun's Leben," by Mrs. C. Mettenius, where are many details of the whole affair, even including letters of Braun to Cecile Guyot.

ment in 1840. Miss Emmy Braun was born in January, 1807, and was as gifted as her younger sister Cecile, being an excellent musician. In the spring of 1841 she married Mr. Eichhorn, Hofmuziker at Carlsruhe. All four of the Braun children were talented.

As for the engagement of Agassiz and Miss Cecile Braun, although Alexander and his mother were not very enthusiastic in regard to it, — for both saw how fully Louis was engrossed in his studies and in himself, and realized his tendency to fly from one subject to another, and his want of steadiness and of business capacity, — nevertheless during the vacation of 1833, it became "un fait accompli"; and in October Agassiz brought his wife home to Neuchâtel, to a small apartment "au faubourg du Lac," No. 21.

Mrs. Cecile Agassiz, born at Carlsruhe the 29th of July, 1809, was a lady with regular and fine features, slender, and of very dark complexion, so much so that she looked more like an Italian or Spaniard than a German. She possessed rare artistic talents, being a pupil of an artist of some repute, Marie Ellenrieder of the Nazarean school, after the style of Fra Angelico. Before her marriage she made many aquarelles of fossil and fresh-water fishes for her "fiancé," remarkably exact and well executed, which rivalled those made by the painter Dinkel. She also painted specimens of plants for her brother Alexander. Besides this, she was well acquainted with German literature, and was generally an accomplished young lady. She was a great favourite in her family, and was widely acquainted in Carlsruhe. She was greatly disappointed in Neu-

châtel; everything was so different from her delightful home at Carlsruhe. She did not speak French fluently, and possessing to a high degree the German placidity which borders on complete indifference, she was not well impressed by what she saw, and from the first disliked all Agassiz's friends and acquaintances. Accustomed to the beautiful green fields and forests of the vicinity of Carlsruhe, she found herself enclosed by dusty or muddy roads, by high vineyard walls, and the rather inhospitable aspect of the houses: all this, with the reserve and rather cold manners of the inhabitants, disposed to copy the formality of the Prussian court, displeased her so much that she soon greatly disliked the "Neuchâtelois," Neuchâtel, and even Switzerland. For her, Carlsruhe was paradise on earth, and her only wish was to return and live there.

Agassiz, during the first three years of his married life, showed more than at any other period the brilliancy of his rare intellect, the deepness of his devotion to the progress of natural history, and the greatness of the effort he was able to make to place himself among the foremost naturalists of the time.

During the spring of 1834, the first number of the "Poissons fossiles" came out, and made a great sensation among geologists and zoölogists. The subject had until then baffled all palæontologists, no one having ventured to go deeply into it, on account of osteologic difficulties and the material obstacle of drawings. The most difficult to please declared the work remarkably executed, and Agassiz received approbation and congratulations from every quarter. Undoubtedly the first

"livraison" fully deserved such a reception. Agassiz never surpassed, perhaps never equalled, that first number of the "Fossil Fishes." It is the work of a great master.

A few days after, in May, 1834, another memoir, also very remarkable, was read before the Natural History Society of Neuchâtel on "Quelques Espèces de Cyprins du lac de Neuchâtel" ("Mémoires Soc. Sc. nat. de Neuchâtel," Vol. I., p. 33). In this Agassiz shows his tendency to create new genera and his admirable talent for description of species and for classification.

In August, 1834, Agassiz made a long-desired visit to England. Buckland, Lyell, and others received him with open arms. His visit coincided with François Arago's journey to collect material for his academic eulogy of Watts, and as he had become well acquainted with Arago during his sojourn at Paris in 1832, they were much together, meeting at Oxford at the hospitable home of Buckland, and travelling together to Edinburgh, and back to Paris.

Agassiz found such a wealth of fossil fishes that he wrote at once to his artist, Dinkel, to come over. One of the rooms of the Geological Society, then at the Somerset House, was generously placed at his disposal by the society, and as soon as he had collected there some two thousand specimens, he began in earnest his studies of comparison, determination, and classification, and directed Dinkel to draw all specimens worthy of being reproduced for his great monograph, or even such as might prove useful afterward for general

description. Dinkel remained in England for several years, either in London, or at the country seat of Philip Egerton, near Chester, and at Enniskillen in Ireland, and made one of the best and most valuable collections of drawings of fossil fishes, which was afterward purchased by the subscriptions of English geologists, and presented to the British Museum.

On the 3d of December, 1834, at a meeting of the Neuchâtel Society of Natural History, Agassiz delivered a lecture on the present state of natural science in England, on the splendid collections of fossils and living animals there, and more particularly on the great progress and extraordinary enlargement of the Zoölogical Garden of London.

The echinoderms had already attracted much of his attention. The peculiar beauties of these fossils, their great numbers around Neuchâtel and in the Jura Mountains, and the ease of identifying them, even from fragments, led him to undertake a "Monographie des Echinodermes." At the meeting of the Neuchâtel Society, Jan. 10, 1834, he made a communication, in abstract, of the main discoveries already arrived at by his researches, and his memoir entitled, "Notice sur les fossiles du terrain crétacé du Jura Neuchâtelois" ("Mémoire Soc. Sc. nat. de Neuchâtel," Vol. I., p. 126, 1835) began his series of publications on "Echinides." He describes twelve species found in the cretaceous rocks of Neuchâtel, eight of which were entirely new. The paper is marked by great originality of classification, clearness of description, and exactness of

drawing. It succeeded better than any other publication in showing that the cretaceous strata of Neuchâtel were a special formation, differing from the Green Sand and Gault of England, and, at the same time, younger than the Portland stone of the Jurassic system. At that time, the name *Neocomian*, to designate the Neuchâtel strata of the Lower Cretaceous had not yet been used by Thurmann, who offered it at a meeting of Jurassian geologists at Besançon, in September, 1835.

The "Prodrome d'une monographie des Radiaires ou Echinodermes," read also before the Neuchâtel Society on the 10th of January, 1834, was published in 1835, at page 168 of the first volume of the memoirs of that society; it is the starting-point of all the publications on the echinoderms, according to the principles of classification of Cuvier. Agassiz followed the method of his master; and in the first twelve pages he gives a most remarkable exposition of their zoölogical characters, and of his views on the classification and determination of the genera of that class of marine animals. Curiously enough, a year and a half later, in August, 1835, Charles Des Moulins, an able zoölogist of Bordeaux, without any knowledge of the works of Agassiz, published his "Études sur les Echinides," in three papers; Bordeaux, 1835–1837. The first two, published in August and December, 1835, contain no reference to Agassiz's researches; but the third paper, dated September, 1837, contests the *priority* of some of the genera created by Agassiz. As a whole, the two memoirs by Agassiz and

Des Moulins contain many similar results, and their coincidence of publication and of result, due to a mere accident, is very honourable to both. Des Moulins presented more facts and observations on the living and Tertiary echinoderms, while Agassiz brought forward more new forms and new genera from the secondary (Cretaceous and Jurassic) echinoderms, and also a better bibliographical knowledge of the subject.

The "Tableaux synonymiques des Echinides" of Des Moulins, is another "Prodrome," corrected and finished, according to Des Moulins himself, in April, 1837, more than a year after the publication of Agassiz's "Prodrome." Des Moulins says that when, on the point of finishing the manuscript of his "Tableaux synonymiques," he received from Agassiz a copy of his "Prodrome," and that he was thus enabled to interpolate all Agassiz's synonymy, including also the names of species described in works by several writers which Des Moulins did not possess and had never seen. The question of *priority* was settled by Des Moulins, in favour of Agassiz; Des Moulins's claims to priority being limited to two genera: *Collyrites* instead of *Disaster* of Agassiz, and *Echinocidaris* instead of *Arbacia* of Gray; a detail simply in Agassiz's classification of the great family of Echinoderms.

The winter of 1834–1835 and all the spring of 1835 were devoted to his great work on fossil fishes, the echinoderm studies being considered by Agassiz as a sort of relaxation and recreation. New numbers of the "Poissons fossiles" were issued, the text not corresponding

with the atlas of plates, which at the time rendered rather difficult and confusing the task of those who wanted to follow him. His two friends of Berlin, Leopold von Buch and Alexander von Humboldt, complained of this, and von Buch went so far as to call his method of issuing text in fragments from different volumes *diabolical.* Humboldt, although calling Agassiz, in his letter of the 10th of May, 1835, "a great and profound naturalist," and speaking of his "admiration of your eminent works," adds: "I also complain a little, though in all humility; but I suppose it to be due to the difficulty of concluding any one family of (fossil fishes), when new materials are daily accumulating on your hands. Continue then as before. In my judgment, M. Agassiz never does wrong." To any one who knows how sarcastic and sharp Humboldt was, it is surprising to see him treating Agassiz so tenderly, using circumlocution in admonishing him, and placing the burden of sharpest criticism on his friend von Buch.

The isolation of Agassiz in a small town, beyond direct intercourse with other naturalists and savants in general, had already begun to tell. If he had been exposed to daily friction with his fellow-naturalists, he would have avoided many mistakes and false steps.

In July, 1835, Agassiz took his young wife on a visit to her parents at Carlsruhe, and left her there while he went a second time to England, where he remained until the end of October, working hard at descriptions of all the fossil fishes he had collected the previous year, and revising and directing the work of his two artists; for

besides Dinkel, he now had a second draughtsman, M. Weber, another of his Munich friends. The expenses had grown so large that he began to think that he had "committed an imprudence in throwing myself into an enterprise so vast in proportion to my means as my 'Poissons fossiles.'" His publisher, Cotta of Stuttgart, had abandoned the undertaking as being too expensive and attended with too many *aleas*, and Agassiz bravely resolved to be his own publisher, — a very rash decision on his part, taking into account his complete lack of business capacity; but as he says: "Having begun it, I have no alternative; my only safety is in success. I have a firm conviction that I shall bring my work to a happy issue, though often in the evening I hardly know how the mill is to be turned to-morrow."

At the meeting of the British Association for the advancement of science in Dublin, which Agassiz attended, another appropriation of one hundred guineas, similar to the one voted the preceding year toward the facilitating of researches upon English fossil fishes, was granted him, which allowed him to pay his two artists. His presence in England and Ireland greatly helped the subscriptions to his work. English savants acted generously, and Agassiz's reputation grew rapidly among them. But, nevertheless, English enthusiasm never went so far as to offer him a single official position during his whole life.

In France the number of subscriptions was far below what it was in England, only fifteen copies being disposed of. Again, at this time, the loss of Cuvier was

felt; for he alone would have had the power to get a subscription for fifty or sixty copies from the government, as he did for his "Poissons vivants," which would have placed Agassiz at ease. Properly engineered, Agassiz might have succeeded in getting the French government interested in his great work, but for some reason he withdrew from the undertaking, and did not even make an attempt in that direction during his stay in Paris.

An incident occurred at Dublin, during the meeting of the British Association, which was recorded in a letter from Adam Sedgwick to Lyell, dated Sept. 20, 1835. Sedgwick says: "Agassiz joined us at Dublin, and read a long paper to our section (the Geological Section). But what think you? Instead of teaching us what we wanted to know, and giving us of the overflowing of his abundant ichthyological wealth, he read a long, stupid, hypothetical dissertation on geology, drawn from the depths of his ignorance. And, among other marvels, he told us that each formation (*e.g.*, the lias and the chalk) was formed at one moment by a catastrophe, and that the fossils were by such catastrophes brought from some unknown region, and deposited where we find them. When he sat down, I brought him up again, by some specific questions about his ichthyological system, and then he both instructed and amused us. I hope we shall, before long, be able to get this moonshine out of his head, or at least prevent him from publishing it. His great work is going on admirably well. I think it is by far the most impor-

tant work now on hand in the geological world" ("Life and Letters of Sedgwick," Vol. I., p. 447, Cambridge, 1890). Agassiz wisely withdrew his very objectionable paper. It was one of the weak points of his disposition to indulge in wild suppositions on subjects of which he knew very little, and to plunge into speculation absolutely out of his range of research.

It was on this occasion, at a festival at Florence Court, the seat of Lord Enniskillen, that Enniskillen, as it was related by his son, Lord Cole, to Lyell, was put "in great good humour," for long time after, by the perfect coolness with which Agassiz made "Murchison and some other guest *glorious*, and Sedgwick *comfortable*."[1] Such a jolly set of hammer-bearers Lord Enniskillen had never seen before, and Murchison acknowledged that he had found in Agassiz his master. At the hospitable table of Lord Enniskillen the old Munich student proved a match for the old trooper of the Peninsula War.

Not long after his return to Neuchâtel, a son, Alexander, so named in honour of Agassiz's best friend, Alexander Braun, was born on the 1st of December, 1835. For more than one reason it was a great event in the family, for from that moment Mrs. Agassiz, who showed herself at once an excellent and most careful mother, entirely abandoned pencil and books, and devoted all her time and strength to her son, and afterward to her two daughters, — one Ida, born Aug. 8, 1837; and the other, Pauline, born Feb. 8, 1841.

[1] "Life of Sir Charles Lyell," Vol. I., p. 457, and also "Life and Letters of Sedgwick," Vol. I., p. 445.

Indeed, with the scanty means at her disposal, Mrs. Agassiz had her hands full, and even more than full, as we shall see by and by; and it is not surprising that she could no longer manifest active interest in her husband's scientific work. It would have been beyond human power to continue her work of drawing fossil fishes and helping at manuscripts.

But we must not anticipate: let us return to Agassiz's various and constantly increasing work at Neuchâtel. Four letters written at this time to two naturalists, who were counted among his best and most trusted friends, Jules Pictet of Geneva and Célestin Nicolet of La Chaux-de-fonds, will give an intimate view of his scientific activity.

NEUCHÂTEL, 24 novembre, 1833.

MONSIEUR JULES PICTET,
à Genève.

Monsieur, — Je viens de recevoir votre lettre et je m'empresse d'y répondre, dans l'espoir d'obtenir le plus vite possible les objets que vous voulez bien offrir à notre Musée. J'espère que dès à présent, nous pourrons entrer en relations d'échanges suivies. M. Coulon et moi sommes dans ce moment occupés à ranger, et à déterminer les collections, pour en mettre les doubles à notre disposition, ce qui facilitera beaucoup nos échanges. . . . En échange nous pouvons vous offrir en général surtout des Poissons surtout plusieurs espèces d'eau douce nouvelles et inédites, des Mollusques en esprit de vin et des coquilles d'espèces vivantes, des coquilles fossiles surtout du Lias et des étages jurassiques inférieurs du Würtemberg, des Zoophytes en esprit de vin et des fossiles; des roches, surtout des séries complétes du Grés Bigaré, du Muschelkalk, du Keuper et des terrains jurassiques; les fossiles et les roches de la Craie des environs de Neuchâtel qui sont très nombreux. Nous avons aussi beaucoup de doubles des plantes d'Allemagne. Voilà

donc assez de matériaux pour faire de nombreux échanges ; veuillez seulement, s'il vous plait préciser davantage ce que vous désirez recevoir d'abord, et puisque vous voulez bien nous faire le premier envoi ne pas trop tarder à le faire. Si vous aviez, des *Diceras* et en général des fossiles de la Montagne des Fis (Savoie), vous nous obligeriez beaucoup de nous en envoyer, nous voudrions pouvoir les comparer avec notre Craie. Si vous avez des espèces de poissons du Brésil qui ne soient pas mentionnées dans mon ouvrage, elles seraient aussi bien venues pour notre Musée.

Je fais maintenant imprimer la 2ème livraison des "Poissons fossiles," qui contiendra la description des genres *Platysomus*, *Tetragonolepis*, *Dapedium*, *Lemionotus*, et *Lepidotus*, et une partie de l'Ostéologie générale des poissons. Il est fâcheux que les publications périodiques obligent les auteurs à morceler leurs sujets ; mais enfin avec le temps on finit par les rendre complets.

Puisqu'enfin vous voulez bien m'offrir votre appui dans mes recherches sur les objets qui vous entourent de plus près, oserai-je vous prier de bien vouloir m'adresser par la Méssagerie, un jour qu'il fera froid ; un exemplaire de votre Gravanche, et une ou deux de Féra, de différentes dimensions. Je vous offre en échange les Corégones du lac de Constance, de Bavière et de Neuchâtel. Je crois avoir vidé la question des Salmones d'Europe, ce n'est plus qu'à la synonymie que je dois donner encore quelques soins ; aussi je cherche à receuillir tous les noms de province. Cuvier dans la 2ème édition du "Règne Animal" a admis beaucoup trop d'espèces.

Agréez, Monsieur, l'assurance de mon dévouement, et de ma considération distinguée.

Ls. Agassiz.

Neuchâtel, 22 avril, 1835.

Monsieur Jules Pictet.
à Genève.

Monsieur, — Depuis que j'ai eu le plaisir de correspondre avec vous pour notre premier échange, l'arrangement de nos poissons s'est très avancé et une grande partie de la collection est triée, et les doubles sont mis à part. Il nous est donc maintenant bien plus facile d'effectuer les échanges que précédemment ; cependant nos catalogues ne sont point encore faits. C'est pour cette raison, Monsieur, que tout en acceptant avec reconnaissance l'offre que vous me faites pour notre Musée, je vous prierais si cela pouvait vous convenir, de bien vouloir nous envoyer un exemplaire de toutes les espèces de poissons exotiques que vous possédez ; en revanche, je vous adresserai tout ce que vous n'avez pas encore de mes poissons d'eau douce, et si cela ne suffit pas, j'ai encore quelques exemplaires de poissons des grandes rivières du Brésil. Enfin j'ai rapporté d'Angleterre une telle masse de fossiles, que je ne serais pas embarrassé de vous transmettre l'équivalent des poissons que vous me feriez parvenir. Si parmi vos espèces il s'en trouvait que nous eussions, ce dont je doute, je pourrais vous les renvoyer avec les nôtres.

S'il vous manque beaucoup de poissons de la Méditerranée, je pourrais vous en fournir beaucoup. Je désirerais également beaucoup connaître les poissons du lac de Lugano, du moins les espèces des genres critiques.

Je pense ne plus renvoyer d'un an, la publication de mes "Poissons d'eau douce" ; la 5ème livraison des (Poissons) fossiles paraîtra dans six semaines.

Agréez, Monsieur, l'assurance de ma considération distinguée, et de mon entier dévouement.

Ls. Agassiz.

NEUCHÂTEL, le 4 Mars, 1834.

MONSIEUR CÉLESTIN NICOLET,
à La Chaux-de-fonds.

Monsieur, — J'ai reçu il y a 15 jours et lu le même soir à notre société la notice détaillée que vous nous avez adressée sur le calcaire lithographique des Montagnes (de Neuchâtel). Votre communication a excité l'intérêt qu'elle mérite et tous les membres de la société vous féliciteront de votre zèle si vous parvenez à découvrir quelque localité où l'on puisse lever des plaques assez grandes pour exécuter les travaux lithographiques.

Il se rattache une question géologique à vos recherches qui me parait importante sous le point de vue scientifique, c'est l'appréciation rigoureuse des rapports de position qui existe entre votre calcaire lithographique et celui de Sohlenhofen. En Bavière le calcaire est stratifié en couches horizontales et c'est surement de là que vient la beauté des pierres de Sohlenhofen ; tandisque dans la chaine du Jura tous les calcaires ont été disloqués pas des soulèvements postérieurs à leur déposition et sont par conséquent très fendillés. Il serait bien intéressant d'avoir une collection un peu étendue des fossiles de votre calcaire afin de pouvoir les comparer avec le grand nombre de ceux que l'on trouve à Sohlenhofen ; ce serait un moyen de plus de déterminer les relations géologiques de ces dépôts. Si vous avez occasion d'en receuillir, ne le négligez pas ; ce serait un grand service que vous nous rendriez de nous en adresser le plus d'échantillons possibles.

Agréez, Monsieur, l'assurance de ma considération distinguée.

LS. AGASSIZ.

NEUCHÂTEL, le 19 Mars, 1835.

MONSIEUR CÉLESTIN NICOLET,
à La Chaux-de-fonds.

Monsieur, — La Société des Sciences Naturelles de Neuchâtel ayant décidé d'imprimer ses mémoires a nommé un comité pour en faire un choix et soigner l'impression. Ce comité désirant voir vos observations géologiques figurer dans son receuil m'a chargé de vous demander l'autorisation de faire imprimer votre notice sur

la pierre lithographique des montagnes,[1] en vous priant d'y ajouter d'abord vos nouvelles observations sur les gisement de ces couches, sur leur âge géologique, et sur les fossiles qu'elles contiennent. Vous nous obligerez infiniment en répondant bientôt à notre appel. Déjà les premières feuilles de nos Mémoires sont imprimées.

J'ai beaucoup regretté de ne m'être pas trouvé à Neuchâtel lorsque vous vous y êtes réunis avec Messieurs Voltz, Thurmann et Thirria; mais j'espère avoir bientôt le plaisir de faire votre connoissance, M. Ladame m'ayant proposé il y a déjà quelques temps de faire une course avec lui à la Chaux-de-fonds.

Agréez, Monsieur, l'assurance de ma considération très distinguée.

Ls. Agassiz.

[1] "Essai sur le calcaire lithographique des environs de La Chaux-de-fonds" ("Mémoires de la Soc. Sc. nat. de Neuchâtel," Vol. I., p. 66, 1835).

CHAPTER V.

1836–1837.

The Wollaston Medal — First Paper of de Charpentier on the Glacial Theory — Venetz's Observations on Large Boulders perched on the Sides of the Alpine Valleys — Dr. Hermann Lebert, the First Disciple and Pupil of de Charpentier and Venetz — Extract from de Charpentier's First Paper — Agassiz's Summer Vacation at Bex, near the House of de Charpentier — Conversion of Agassiz to the Glacial Theory; His Creation of the Ice-age — Karl Schimper visits Agassiz at Bex and at Neuchâtel — Discours de Neuchâtel July 24, 1837, on the Ice-age.

The year 1836 was happily inaugurated by the reception of the Wollaston Medal, awarded to Agassiz by the Geological Society of London, at its annual meeting on February 19. The President, Charles Lyell, a life-long friend of Agassiz, in presenting the medal, said: —

On a former occasion we presented the proceeds of the Donation Fund [1] for one year to the same distinguished naturalist. to assist him in the publication of the early part of his great work, the importance of which was then only beginning to be known to the scientific world. It will ever be a subject of gratification to us to have learned that this small pecuniary aid was not without its influence in accelerating the publication of his "Researches on

[1] The sum of thirty guineas, or £31, 10*s.* sterling.

Fossil Fish," arriving as it did opportunely at a moment when the funds which could be appropriated for the undertaking were nearly exhausted. Mr. Agassiz acknowledged at the time his obligation to us for a mark of sympathy and regard which he received so unexpectedly from a foreign country, and which cheered and animated him to fresh exertions. The Council, in now awarding the Medal to him, are desirous that he should possess a lasting testimony of their esteem and of the high sense which they entertain of the merit of his scientific labours.

It was a well-deserved reward, received when quite a young man, — in his thirtieth year only, — which did honour to the Geological Society of London as well as to the recipient. Never since has the Wollaston Medal been bestowed on so young a naturalist; his is a unique case, and as such is recorded on the List of Awards of the Wollaston Medal.

In 1834, at the meeting of the Helvetic Society of Naturalists, at Lucerne, Jean de Charpentier, Director of the Salt Works at Bex, Canton de Vaud, had read a short paper entitled, "Notice sur la cause probable du transport des blocs erratiques de la Suisse." Seldom, if ever, has such a small memoir so deeply excited the scientific world. It was received at first with incredulity and even scorn and mockery, Agassiz being among its opponents. Its publication, however, a year later, and again eighteen months later, in the "Annales des Mines" of Paris, Vol. VIII., p. 219, and in the "Bibliothèque universelle" of Geneva, Vol. IV., p. 1, with a German translation by Julius Froebel and Oswald Heer, in "Mittheil. aus dem gebiete der theoret. erdkunde," p. 482, Zürich, attracted much attention, and the smile of incredulity with which it was received

when read at Lucerne soon changed into a desire to know more about it.

A mountaineer, Perraudin, of the Bagnes valley, at the foot of the St. Bernard, in Valais, told de Charpentier, as far back as 1815, that the large boulders perched on the sides of the Alpine valleys were carried and left there by glaciers. De Charpentier thought the hypothesis so extraordinary and extravagant that it was not worth examining or even considering. Fourteen years later, in 1829, at the meeting of the Swiss naturalists at the Grand St. Bernard's Hospital, his good and most esteemed friend, the engineer of the "Ponts et Chaussées" of the Valais Canton, M. Venetz, not only supported the view advanced by Perraudin, but told the Society that his observations led him to believe that the whole Valais has been formerly covered by an immense glacier, and that it even extended outside of the canton, covering all the "Canton de Vaud" as far as the Jura Mountains, carrying all the boulders and erratic materials, which are now scattered all over the large Swiss valley. In 1821 the extremely modest Venetz had read before the Swiss naturalists a paper entitled, "Mémoire sur les variations de la température des Alpes de la Suisse." In some way the memoir was left entirely unnoticed, and the manuscript put aside. De Charpentier, as soon as he was convinced of the correctness of the Venetz theory, hunted up the manuscript, which was buried under the dust of the archives of the Helvetic Society of Naturalists, and had it finally printed and published, in 1833, — twelve years after it was written, — in "Erstern Bandes zweyte abtheilung,"

of the "Denkschiften der allgemeine Schweizerischen Gesellschaft für die gesammten Naturwissenchaften."

As this initial memoir on the glacial epoch is extremely rare, I will quote the conclusions and one paragraph : —

Monsieur Perraudin, conseiller de la commune de Bagnes, habile chasseur de chamois, et amateur de ces sortes d'observations [on old moraines], nous a assuré que les glaciers de Séveren, de Loui, et de la Chaux-de-Sarayer, tous dans la vallée de Bagnes, ont des moraines fort reconnaissables, qui sont environ à une lieue de la glace actuelle. . . .

Nous sommes donc en quelques manières autorisés à croire : —

1) Que les moraines qui se trouvent à une distance considérable des glaciers, datent d'une époque *qui se perd dans les nuits des temps*. . . .

6) Que les glaciers parviendront difficilement à la hauteur gigantesque, dont nous trouvons tant de vestiges. . . .

Civil Engineer Venetz was not educated as a scientific man, and he did not understand the scientific method of marshalling and classifying facts and observations. But he found in his friend de Charpentier the best possible man to systematize and construct a new science. If it was Venetz who developed and sustained the hypothesis of the chamois hunter, Perraudin, and awaked de Charpentier's interest in the question, it was de Charpentier, who by his scientific method of observation, his clear and logical reasoning, accumulated and classified on truly scientific bases all the material proofs, such as the *moraines,* the *roches moutonnées polies et striées,* the *cailloux striés,* the *boue glaciaire*, etc., and to de Charpentier is due the glacial doctrine and the glacial theory.

As early as 1833, de Charpentier had gathered round

him at Bex, pupils and believers in the new science, including among the first ones O. Heer, afterward so celebrated for his researches in fossil botany and fossil entomology, E. Thomas, the botanist, and the learned Dr. H. Lebert. The latter, a brilliant German political refugee from Breslau, an enthusiastic friend and great admirer of de Charpentier, who justly compared the splendid and characteristic profile of de Charpentier to that of Keppler and of Galileo, and pronounced his head as typical of a savant, came to Bex in August, 1833, and was there convinced of the soundness of the views of Venetz and de Charpentier. For him the beautiful demonstrations of de Charpentier were conclusive, and left no doubt; so much so that in 1834, on the occasion of his receiving his degree of Doctor of Medicine at Zürich, and before de Charpentier had read his paper at Lucerne, he gave a public lecture on the glacial theory.

The just and honest Heer, in his "Le Monde primitif de la Suisse," has nobly upheld the claims of de Charpentier, saying: "C'est Jean de Charpentier qui le premier donna une base scientifique à cette hypothèse par une série de recherches consciencieuses et par une rigoureuse combinaison des faits connus." And he further says: "Jean de Charpentier est le fondateur de la théorie des glaciers."

The short paper of de Charpentier contains some of the fundamental principles on which the glacial theory is based, and is so important that some extracts will be acceptable to all those who like to follow the history of a great discovery from its infancy.

Extracts from NOTICE SUR LA CAUSE PROBABLE DU TRANSPORT DES BLOCS ERRATIQUES DE LA SUISSE; *par M. J. de Charpentier, Directeur des mines du canton de Vaud.* (*Extrait du Tome VIII des "Annales des Mines," pp.* 20. *Paris,* 1835.)

M. Venetz, en étudiant les glaciers, a été conduit à s'occuper des blocs erratiques transportés par la vallée du Rhône, et l'examen qu'il a fait de ces blocs, et des diverses circonstances qui les accompagnent, l'a convaincu que leur transport n'a pas pu s'effectuer par le moyen de l'eau, quelque énormes qu'on suppose son volume et sa vitesse, et quelque puissante que soit son action. . . .

Les dépôts des blocs erratiques présentent constamment un mélange informe de fragmens de toutes les dimensions, depuis celle d'un grain de sable jusqu'à celle de plusieurs milliers de pieds cubes. On trouve sur le Jura des blocs aussi volumineux que dans les vallées des Alpes. Il n'existe donc point de triage selon les volumes et les poids relatifs des blocs, ce qui nécessairement aurait dû avoir lieu s'ils avaient été entraînés et amenés par l'eau; car, dans ce cas, les plus gros blocs devraient se trouver les plus voisins du lieu d'où la débâcle et le courant les auraient enlevés, et ces fragmens devraient diminuer de volume à mesure qu'ils en sont plus éloignés, de manière que les blocs qu'on trouve sur les pentes du Jura devraient être en général sensiblement plus petits que ceux qu'on rencontre au pied et dans les vallées des Alpes. Mais, nous le répétons, un pareil arrangement ne s'observe nulle part. . . .

Quoique la plupart des blocs erratiques présentent une forme arrondie évidemment par frottement, on en trouve néanmoins qui sont non-seulement aplatis, mais qui sont restés presque intacts, ayant à peine leurs angles et leurs arêtes écornées ou émoussées. Si leur déplacement avait eu lieu par un courant, on ne saurait pas concevoir comment ils auraient pu être roulés jusques au pied du Jura et poussés sur son faîte, sans porter des marques violentes de frottement.

Les dépôts de ces roches transportées présentent ordinairement une forme alongée, semblable à celle d'une digue ou d'un rempart,

ou bien ils forment quelquefois des monticules coniques, isolés ou disposés en file. Ils ne se rencontrent jamais en forme de nappe ou de plateau. Ces digues sont placées horizontalement au pied et sur la pente des montagnes, ordinairement les unes derrière les autres, et espacées à des distances inégales : elles sont parallèles entre elles et à la direction de la vallée. Quelquefois deux ou plusieurs de ces digues se trouvent tellement rapprochées les unes des autres, qu'elles se confondent en une seule, terminée par une ou plusieurs arêtes. La plus grande élévation à laquelle on les trouve sur la pente des montagnes qui bordent la vallée du Rhône, est d'environ 1.100 à 1.200 pieds au-dessus de ce fleuve, dans les environs de Bex, et de 2.400 pieds dans ceux de Sion. Le sol sur lequel ils reposent n'est jamais formé d'atterrissemens ou d'éboulemens, mais c'est toujours du roc en place.

La disposition et la configuration extérieure de ces dépôts sont inexplicables par la théorie d'un transport par le moyen d'un courant d'eau ; car l'eau les aurait déposés en forme de nappes, surtout dans les plaines des vallées et dans celles qui se trouvent au pied des Alpes ; cette théorie n'explique pas non plus comment ces blocs auraient pu franchir, sans les combler, les lacs qui se trouvent à l'extrémité inférieure de la plupart de nos grandes vallées, ni la singulière position de ces énormes blocs qu'on trouve isolés dans la plaine ou sur la pente des montagnes, plantés verticalement sur le sol, et quelquefois brisés ou fendus du bas en haut dans toute leur longueur, ce qui semble indiquer qu'ils sont tombés à peu près verticalement sur la place même où ils se trouvent encore, et qu'ils se sont fendus ou brisés par leur chute.

On remarque en outre que les blocs sortis d'une vallée latérale ne se mêlent point ou très imparfaitement avec ceux de la grande vallée, ou avec ceux qui sont sortis d'une vallée opposée. Ainsi les pierres feldspathiques ou talqueuses de la vallée d'Hérens, formant des dépôts considérables près de Sion, ne se mêlent point avec les blocs calcaires qui proviennent des vallées de la Sionne et de la Lierne, qui toutes les deux prennent naissance auprès de Rawyl, et se terminent à la grande vallée du Rhône, à peu près vis-à-vis de la vallée d'Hérens. Les digues ou remparts qu'imitent les dépôts de blocs de chacune de ces vallées sont parfaitement séparés et distincts.

Feu M. Escher de la Linth avait déjà remarqué ce même fait par rapport aux grandes vallées de la Suisse, c'est-à-dire que les blocs erratiques de la vallée du Rhône ne se mêlaient point avec ceux qui étaient sortis de la vallée de l'Aar; que ces derniers restaient séparés et distincts des dépôts de blocs venus de la vallée de la Reuss, etc. En admettant un courant d'eau ou une débâcle qui ait eu lieu instantanément et à la fois dans ces diverses vallées, on ne comprend pas pourquoi et comment les pierres entraînées ne se mêlaient pas dans les endroits où ces courans venaient se toucher et se joindre, et surtout là où ils frappaient contre le Jura, ce qui aurait dû produire une sorte de remou ou de refoulement, qui loin d'empêcher le mélange des matériaux que ces courans amenaient avec eux, l'aurait au contraire singulièrement favorisé.

Un autre phénomène qu'on observe dans les vallées de toutes les chaînes de montagnes qui ont fourni des blocs erratiques, ce sont les surfaces lisses que présentent les rochers qui n'ont pas été dégradés par la décomposition ou par des éboulemens. Ces surfaces sont évidemment le résultat d'un frottement, et comme on sait que les eaux courantes qui charrient du sable et des pierres, usent et polissent les rochers avec lesquels elles viennent en contact, on a cru que les surfaces lisses et usées des rochers de nos grandes vallées étaient dues à la débâcle ou au grand courant qu'on supposait avoir transporté les blocs erratiques, qui, en quelque sorte, auraient fait office de l'émeril. Pour donner plus de probabilité à cette explication, on alléguait le fait incontestable que ces surfaces polies ne se rencontrent pas audessus du niveau que les blocs transportés ont atteint de chaque côté de la vallée, et qu'au-dessus de ce niveau les rochers n'offrent que des surfaces raboteuses, de véritables cassures.

La supposition d'une débâcle ou d'un courant n'explique pas d'une manière satisfaisante ce phénomène; car comment concevoir qu'une si immense quantité de blocs de toutes les dimensions, mise en mouvement par une énorme masse d'eau, ait pu unir et rendre lisses des surfaces verticales et d'une grande étendue? Loin de les polir, elle n'aurait fait que les écorner et les ébrécher. Comment des blocs entraînés par l'eau auraient-ils pu frotter et user des surfaces qui surplombent, qui forment ces sortes de voûtes que nos montagnards désignent par le nom de *barmes* ou de *balmes*? Com-

ment expliquer, par cette supposition, la formation de surfaces polies, derrière des rochers qui font saillie, et qui, par ce fait même, auraient dû les préserver du courant, et les protéger contre le choc et le frottement des corps solides charriés par l'eau?

Mais laissons de côté ces difficultés et admettons pour un moment que ces surfaces lisses avaient été produites par un courant d'eau; dans ce cas elles devraient être plus marquées vers l'extrémité inférieure des vallées que dans leur partie supérieure ou vers leur naissance, et elles devraient être absolument nulles sur les côtés des Alpes. Eh bien, c'est précisément le contraire; ces surfaces lisses et polies se recontrent depuis le pied jusqu'au faîte des Alpes, et plus on s'élève, mieux on les trouve prononcées; elles sont extrêmement distinctes sur le Saint-Bernard, le Simplon, le Saint-Gothard, le Grimsel, la Gemmi, le Sanetsch, le col d'Enzeindaz, etc. . . .

Je pourrais citer encore d'autres faits plus ou moins contraires à la théorie d'un courant d'eau, si ceux que je viens d'indiquer ne me paraissaient pas suffire pour faire soupçonner que l'agent qui a transporté les blocs erratiques a été tout autre qu'une débâcle ou une masse d'eau en mouvement.

M. Venetz croit que des *glaciers* ont été cet agent, et que ces dépôts de blocs erratiques ne sont autre chose que des *moraines*.

Je sens fort bien tout ce qu'une pareille hypothèse offre au premier abord d'invraisemblable, de choquant, d'extravagant même. En effet, comment admettre, comment se persuader que jadis toutes nos grandes vallées fussent occupées dans toute leur longueur par de vastes glaciers, qui, à leur débouché dans la plaine au pied des Alpes, se seraient étendus en forme de nappes ou d'énormes éventails pour couvrir presque toute la contrée jusqu'au Jura, et remonter cette chaîne en nombre d'endroits jusques à son faîte, et le dépasser même? Comment concilier une semblable hypothèse avec la masse de faits qui prouvent que jadis la température de nos climats a été bien plus élevée qu'elle ne l'est maintenant? . . .

J'avoue que toutes ces objections et beaucoup d'autres se présentèrent à moi lorsque M. Venetz, il y a environ cinq ans, me fit part de son opinion. Je restai dans le doute, jusqu'à ce que les faits que j'avais mis tant de soin à rechercher et à examiner pour com-

battre cette hypothèse, m'eussent conduit à un résultat tout opposé à celui auquel je m'étais attendu. . . .

Les glaciers et leurs moraines se plaçant devant l'entrée de quelque petite vallée latérale, y forment une sorte de barre, qui, empêchant l'écoulement des eaux, change le vallon en lac, dans lequel les torrens amènent des pierres, des sables et des limons, et les déposent par lits. Il n'est donc pas surprenant de rencontrer quelquefois auprès des dépôts des blocs erratiques de petits amas de matériaux évidemment stratifiés et déposés par l'eau.

Quoique la plupart des blocs charriés par les glaciers soient arrondis, ou aient au moins leurs angles et leurs arêtes émoussés ou écornes par le frottement qu'ils éprouvent les uns contre les autres, néanmoins on trouve quelquefois sur le dos des glaciers de gros blocs isolés qui arrivent sans frottement, et par conséquent bien conservés jusqu'au pied du glacier. Ce fait explique la manière dont quelques-uns des blocs erratiques ont pu être transportés à de fort grandes distances sans avoir éprouvé de frottement, et sans que leurs angles et leurs arêtes aient été sensiblement endommagés.

La forme des moraines est celle d'une digue ou d'un rempart, terminé par une ou plusieurs arêtes. Dans certains cas elle est conique, ou bien elle présente une foule de monticules coniques. Lorsqu'un glacier, comme il arrive le plus souvent, a plusieurs moraines, elles sont toujours parallèles entre elles, et placées à des distances inégales. La configuration intérieure et extérieure des moraines, et leur disposition mutuelle sont donc exactement les mêmes que celles des dépôts des blocs erratiques.

Les glaciers ne produisent jamais, comme les torrens et les rivières, de dépôts en forme de lits ou de nappes, parce qu'ils creusent toujours le terrain jusqu'au roc vif, poussant devant eux toutes les terres, graviers et blocs qu'ils rencontrent sur leur passage, phénomène connu de tous ceux qui ont observé des glaciers dans le temps où ils sont en progression, et qui s'explique très bien par la manière dont les glaciers augmentent et avancent. Puisque les glaciers en s'avançant déblaient le terrain jusqu'au roc vif, nous pouvons facilement concevoir pourquoi nos lacs n'ont pas été comblés par la quantité immense de blocs, de gravier et de sable qui ont dû les traverser, ou plus exactement, qui ont dû passer par

dessus, et qui, s'ils avaient été amenés par de l'eau, n'auraient pas manqué de les remplir. . . .

Depuis les travaux de M. de Saussure, tout le monde sait que deux glaciers, lorsqu'ils viennent à s'atteindre et à se joindre sous un angle aigu, ne mêlent et ne confondent point leurs moraines. Ce fait explique parfaitement pourquoi les blocs erratiques d'une de nos grandes vallées ne sont point mêlés avec ceux de la vallée voisine, phénomène duquel on ne saurait se rendre compte par la supposition que le transport de ces blocs eût été opéré par le moyen de l'eau. . . .

On sait que les glaciers frottent, usent et polissent les rochers avec lesquels ils sont en contact. Cherchant à s'étendre, ils suivent toutes les sinuosités, et se pressent et se moulent en quelque sorte dans tous les creux et toutes les excavations qu'ils peuvent atteindre, et en polissent les surfaces, même celles qui surplombent, ce qu'un courant d'eau charriant des pierres ne pourrait effectuer.

Comme les glaciers prennent naissance sur le faîte des Alpes, leur action destructive doit avoir duré beaucoup plus long-temps dans les régions supérieures que dans les basses vallées et à leur pied. Il n'est donc pas étonnant de rencontrer dans les hautes vallées et sur les cols des Alpes des marques de frottement beaucoup plus considérables et mieux prononcées que vers leur pied, ce qui devrait être précisément l'inverse si ce frottement avait été opéré par un courant ou une débâcle. Enfin l'observateur qui part du faîte du Jura dans la direction même où les blocs erratiques y sont arrivés, en suivant constamment leur trace, se trouve conduit jusqu'au fond des hautes vallées des Alpes, et jusqu'aux glaciers qui les dominent, où il voit enfin ces dépôts devenir de véritables moraines. . . .

Je termine cette notice en exprimant le vœu qu'elle puisse attirer l'attention des naturalistes sur le travail que prépare M. Venetz; qu'elle puisse les engager à étudier derechef le grand phénomène des blocs erratiques.

Agassiz resolved to pass his summer vacation of 1836 in a healthy locality among the Alps. At that

time resorts were few, and there were none at all in the centre of the Alps. At about the time of his marriage, in 1833, de Charpentier had invited him to visit him at his beautiful home "aux Dévens," near Bex. De Charpentier, the classmate, at the Freiberg School of Mines, of Alexander von Humboldt and Leopold von Buch, the author of the best geological description of the Pyrenees then existing, had a European reputation which brought to his house savants from every country; in addition, he enjoyed the reputation of a charming and most hospitable companion, and was the possessor of rich collections of natural history. De Charpentier had married, in 1828, a young German lady of noble family, Miss von Gablenz of Dresden; and as Mrs. Agassiz was not particularly fond of Swiss ladies, Agassiz thought that an acquaintance with Mrs. de Charpentier, a German lady of culture and refinement, might be agreeable to his wife.

It is a mistake to think that Agassiz was attracted to Bex by a desire to study the glacial question. He was adverse to the hypothesis, and did not believe in the great extension of glaciers and their transportation of boulders, but, on the contrary, was a partisan of Lyell's theory of transport by icebergs and ice-cakes. His main object was to pass an agreeable vacation with his wife and child, at the foot of the Dent du Midi, and near a family of savants as social and friendly as were de Charpentier and wife. In all this he was not disappointed; but from being an adversary of the glacial theory, he returned to Neuchâtel an enthusiastic convert to the views and observations of Venetz and de Char-

pentier. Agassiz found lodgings in the neighbourhood of "des Dévens," at "la Sallaz," a suburb of the small town of Bex, and daily visited de Charpentier. The site, just north of Bex, on rising ground, among fine orchards and vineyards, is truly magnificent; with luxuriant vegetation, and in full view of the opening of the great valley of the Valais, and at the foot of the Dent du Midi. Mrs. Agassiz, with her little boy Alexander, was delighted with the place, and with Mr. and Mrs. de Charpentier, as well as their only child, a charming girl of seven years, time passed quickly, and Agassiz found in more intimate acquaintance with de Charpentier, another charmer of men, not like himself in many points, but very similar in some. For instance, de Charpentier was a delightful talker, very hospitable, and, like Agassiz, enjoyed hearing the "chime at midnight." The evenings passed like dreams, in endless conversations on scientific subjects. For the greater comfort of the guests collected round his table, — for besides Agassiz there were Dr. Lebert, Em. Thomas, Venetz, Albert Mousson, Escher von der Linth, and Lardy, — de Charpentier ordered the best wine of his cellar, and although moderation prevailed, the conversation was often enlivened, and hour after hour passed so quickly that the company frequently did not separate until a late hour; sometimes not before daybreak. It was a fruitful and genial time for all those who were fortunate enough to be present. Agassiz was soon converted into a glacialist by the arguments, and more especially by the evidences shown him by de Charpentier and Venetz, all round Bex, and in several excursions

to the Valais. With his power of quick perception, his unmatched memory, his perspicacity and acuteness, his way of classifying, judging, and marshalling facts, Agassiz promptly learned the whole mass of irresistible arguments collected patiently during seven years by de Charpentier and Venetz, and with his insatiable appetite and that faculty of assimilation which he possessed in such a wonderful degree, he digested the whole doctrine of the glaciers in a few weeks.

Agassiz saw also that de Charpentier was a true "scientific epicurean" in the best and most elevated sense of the word, as he had been characterized by Dr. Lebert, not only without ambition for fame, but even indifferent as to the diffusion of his discoveries among scientific men. Lebert calls de Charpentier "une Belle au bois dormant"; and it was for Agassiz to play the rôle of the prince in awaking him, and obliging him to publish his researches; which he finally did in October, 1840, under the title of "Essai sur les Glaciers."

Agassiz, with his extraordinary imagination, saw that the phenomenon of the extension of old glaciers had not been confined to the Rhone valley, but must have been general, and formed a special period in the history of the earth, during which cold prevailed all over the world. In a word, Agassiz's sojourn at Bex, under the teaching of de Charpentier, had taught him, with his far-reaching thoughts, to add an entirely unexpected, and, at that time generally very unacceptable, stage to the various periods which the earth had passed through; namely, the Ice-age.

On his return to Neuchâtel, Agassiz began to examine attentively, with the new tool he had obtained at Bex, all the vicinity of Neuchâtel and Bienne, finding everywhere the most unmistakable proofs of glacial action, and of the extension of the glacier of the Rhone to the Chaumont, with its "Pierre à Bot," and far away north towards Soleure.

During his stay at Bex, Agassiz, as a good friend, wished to share the great pleasure afforded to him by his stay near de Charpentier, and he kindly invited Karl Schimper to visit him. As Agassiz said in 1842, in his defence against the attacks of Schimper, "Through the highly interesting works of Venetz and de Charpentier upon glaciers, my attention was called to these phenomena. In the autumn of 1836 I went to Bex, where I spent several months, and under the guidance of M. de Charpentier gradually learned to understand these remarkable phenomena." These plain words cannot leave any doubt as to the fact that Agassiz became converted to the glacial theory by the teaching of de Charpentier. Schimper, who did not leave Bex with Agassiz at the beginning of November, but accepted the hospitality tendered to him by de Charpentier, was not with Agassiz when he made his observations on the polished and scratched rocks and boulders round Neuchâtel. After lingering several weeks at de Charpentier's hospitable and generous house, Schimper rejoined Agassiz at Neuchâtel as his guest, as he had been at Bex and formerly at Munich. Of course, being constantly together, Agassiz and Schimper carried on a continual exchange of views on the Ice-age. During the winter

of 1836–37, Agassiz gave a public lecture at Neuchâtel on the subject. He was continually haunted by his thoughts on old glaciers; and when the Helvetic Society of Natural Sciences, of which he had been elected president, met at Neuchâtel on the 24th of July, 1837, he wrote during the night previous his famous "Discours d'ouverture." In it Agassiz most frankly acknowledges that his explanation of the glacial epoch "est le résultat de la combinaison de mes idées et de celles de M. Schimper." All these explanations are necessary, in order to show exactly how Schimper became involved in the question, and how unjust are the accusations of plagiarism launched against Agassiz by Schimper himself and by Dr. Otto Vogel, in the "Allgemeine Zeitung" of Augsburg. Agassiz's good heart and constant readiness to give impulse to new ideas were interpreted in a manner not exactly creditable.

But before we come to the delivery of his "Discours," let us see how friendly he was to Schimper. As soon as Schimper became a guest in Agassiz's apartment at Neuchâtel, Agassiz introduced him to everybody and made the most of him. At the meetings of the Neuchâtel Society of Natural Sciences, Schimper communicated in February, March, and April, 1837, his observations on the morphology of plants, showing the laws of development of leaves round the axes; and also his new ideas on the development of the animal kingdom before the appearance of man. During the five years which had passed since their last meeting at Carlsruhe in 1832, Schimper had undergone changes which were not to his advantage. He had failed to

draw a line sharply separating his student life from his life as privatdocent and instructor at the Munich University. His appetite, on the contrary, had greatly developed, and was almost beyond his control. However, the society of de Charpentier at Bex and of Agassiz at Bex and Neuchâtel was beneficial to him; and he never was so brilliant and attractive.

On the 15th of February, 1837, which was the anniversary of his birth, Schimper was in particularly excellent spirits. That evening he first made two verbal communications before the Natural History Society on botanic morphology, promising to write them for the "Bulletin," — a promise which, by the way, was never carried into effect, like all Schimper's promises, — and then he distributed to Agassiz and all the friends there a small piece of poetry, half-scientific, half-humorous, in which, for the first time, the word *Eiszeit* (glacial epoch), so celebrated since, was printed. Schimper had the honour to be the god-father of a great geologic period, for it was certainly he who first coined and used the word. Agassiz always acknowledged his *priority;* and on the 25th of July, before the geological section of the Helvetic Society, he read a letter from Schimper, addressed to him under the title of "Ueber die Eiszeit," in which the word *Eiszeit* is written in italics, and so printed on p. 38 of the "Actes de la Société Helvetique," Neuchâtel, 1837.

But poor Schimper soon fell again into bad habits after leaving Agassiz, and the brilliant spirit, the rare genius, — for a man of genius Schimper certainly was, — became more and more obscured, until he disap-

peared entirely, without leaving even a good manuscript account of his great discovery on the morphology of plants.

The "Discours de Neuchâtel" is the starting-point of all that has been written on the "Ice-age." Quoted often, it is, however, very little known, because it never was printed separately and also because the number of copies of the small volume of the "Actes de la Société Helvétique réunie à Neuchâtel" was extremely limited. As it occupies such an important place in the history of the progress of geology, and also in the life of Agassiz, I think it is proper to reproduce it *in extenso* and in French, as it was delivered.

Discours prononcé à l'ouverture des séances de la Société Helvétique des sciences naturelles, à Neuchâtel, le 24 *Juillet*, 1837, *par L. Agassiz, Président.*

Messieurs, très chers amis et confédérés :

Depuis longtemps les membres de la section neuchâteloise de notre société désiraient avec impatience voir arriver le moment où ils pourraient inviter leurs confrères de toute la Suisse à se réunir chez eux. Des circonstances indépendantes de leur volonté, et particulièrement la construction du nouvel édifice dans lequel nous sommes réunis et qui devait recevoir tout ce que la ville possède de collections scientifiques, les ont forcés à décliner l'honneur d'acceuillir à Neuchâtel la Société Helvétique des sciences naturelles, jusqu'à ce qu'ils pussent le faire convenablement et mettre sous ses yeux au moins une partie des collections. Encore aujourd'hui, malgré toute l'activité qu'y a mise l'infatigable Directeur de notre Musée, il n'y a qu'une faible partie des collections qui soient rangées ; c'est même à la hâte qu'elles ont été déposées dans le local qui doit les recevoir et que les ouvriers n'ont pas encore quitté. Nous réclamons donc toute votre indulgence pour ce que vous verrez. Mais du moins, comptez sur le plaisir que nous avons à vous

recevoir ici, et soyez persuadés que nous attachons un grand prix à vous voir chez nous. C'est du fond du cœur que je vous dis à tous : Soyez les bien-venus.

A pareil jour tout nous invite à rechercher quel est le lien qui unit les sciences dont s'occupe notre Société. Je ne crois pas me tromper en affirmant qu'une grande pensée domine tous les travaux qui tendent aujourd'hui à en étendre les limites. C'est l'idée d'un développement progressif dans tout ce qui existe, d'une métamorphose à travers différens états dépendant les uns des autres, l'idée d'une création intelligible, dont notre tâche est de saisir la liaison dans tous ses phénomènes.[1] Ainsi voyez l'Astronomie, qui s'occupe maintenant de la formation des corps célestes ; la Chimie, qui étudie les différens modes d'action des corps les uns sur les autres ; la Physique, qui veut approfondir la nature des forces dont elle connaît l'action ; l'Histoire Naturelle, qui poursuit les phases de la vie de chaque être ; la Géologie enfin, qui se hasarde à embrasser l'histoire de la terre, à en déchiffrer même les pages les plus anciennes, et à la représenter comme un grand tout, dont les révolutions ont toujours tendu vers le même but.

De tous ces progrès, sans doute, il sortira un jour quelque chose de grand, de vraiment *humain*, qui fera rentrer l'étude des sciences naturelles bien plus directement dans le domaine de la vie habituelle de l'homme, que les avantages mêmes fournis à l'industrie et aux arts par les résultats obtenus dans les sciences, quelques immenses qu'aient été ces derniers.

Notre Société n'est point restée étrangère à ce grand mouvement ; les noms de ses membres figurent honorablement à côté des coryphées de la science qui ont daigné s'associer à nos travaux. La réunion d'aujourd'hui, mieux qu'aucune autre peut-être, prouverait que mon assertion n'est point exagérée. Vous le savez, Messieurs, c'est notre petite société qui a servi de modèle à ces vastes associations dont l'Allemagne, l'Angleterre, et la France se glorifient à

[1] If Agassiz had replaced the words "développement progressif" and "métamorphose" by *evolution*, what a splendid Darwinian paragraph he would have given there, in 1837, twenty-two years before the publication of the "Origin of Species." — J. M.

tant de titres ; et si les travaux qu'elle a enterpris ont paru moins brillans, à côté de ceux de sociétés plus vastes, elle n'en a pas moins donné l'élan, à plus d'une reprise.

Tout récemment encore, deux de nos collègues ont soulevé par leurs recherches des discussions d'une haute portée, et dont les suites auront du retentissement. La nature de la localité où nous sommes réunis m'engage à vous entretenir de nouveau d'un sujet qui, je crois, trouve sa solution dans l'examen des pentes de notre Jura. Je veux parler des glaciers, des moraines, et des blocs erratiques.

Tout le monde, en Suisse, connaît les glaciers et sait que leurs bords sont entourés de digues de blocs arrondis qu'on appelle des *moraines*, et qui sont continuellement poussées en avant ou abandonnées par les glaciers à mesure qu'ils avancent ou qu'ils se retirent. Les habitans du Jura surtout sont familiers avec un autre phénomène qui est très frappant dans nos montagnes, je veux parler des *blocs erratiques* ou de ces masses de granit et d'autres roches primitives qui sont éparses principalement sur les pentes de notre Jura. Ce que tout le monde ne sait cependant pas, c'est qu'il existe encore d'autres moraines que celles qui cernent de nos jours les glaciers. Ce sont MM. Venetz et de Charpentier, qui les ont fait connaître les premiers. On les observe principalement dans les vallées inférieures des Alpes. Mais il est un côté de cette question qui doit être contesté, c'est la liaison que l'on a cherché à établir entre les blocs erratiques et les glaciers que cernaient les grandes moraines dont on retrouve encore des traces sur les rives septentrionales du lac de Genève. C'est de ce dernier point que j'ai l'intention de vous entretenir en particulier.

Les *faits* observés par MM. Venetz et de Charpentier sont cependant définitivement acquis à la science ; aussi importe-t-il d'en proclamer hautement l'exactitude ; car de là dépend naturellement la validité de toutes les conséquences que l'on peut en tirer.[1]

A des distances plus ou moins considérables des glaciers actuels, on remarque en effet à différentes hauteurs des moraines parfaitement semblables à celles qui cernent encore les glaciers. Elles sont

[1] It is impossible to say more clearly, or with more force, that Messrs. Venetz and de Charpentier founded the glacial doctrine. J. M.

également concentriques et forment des digues qui suivent les inégalités des flancs des vallées. On en voit partout plusieurs étages, dont les plus élevés se trouvent à quelques cents pieds au-dessus du fond des vallées supérieures des Alpes où il n'y a plus de glaciers. Mais en descendant dans les vallées *inférieures*, on en trouve successivement à douze ou quinze cents pieds et même à plus de dix-huit cents pieds de hauteur; il y en a encore d'assez distinctes à deux mille pieds au-dessus du lit du Rhône, dans les environs de St. Maurice en Valais. On peut les poursuivre jusque sur les rives du lac de Genève. Il en existe encore de très-élevées au-dessus de Vevey et dans les environs de Lausanne, qui correspondent à celles de la rive méridionale du lac.

Si on ne les a généralement pas remarquées, c'est qu'elles sont beaucoup au-dessus des routes fréquentées, et que celles des parties inférieures des vallées ont généralement été disloquées par les torrens.

Il est toujours facile de distinguer ces anciennes moraines des digues formées par le débordement des eaux et des talus plus ou moins étendus, résultant des avalanches. Les digues sont très-irrégulières et s'étendent à de petites distances, en s'aplanissant; les talus sont en forme de cônes très-aplatis, débouchant des vallées et se perdant dans la plaine; tandis que les moraines sont des digues triangulaires continues et parallèles le long des deux flancs des vallées, formées de blocs arrondis évidemment triturés, pour ainsi dire en place, les uns contre les autres, comme cela a lieu sur le bord des glaciers actuels, qui s'étendent dans de longues vallées étroites. Les blocs des avalanches, au contraire, sont anguleux; ceux des digues, charriés par les eaux, peuvent être arrondis, il est vrai, lorsqu'ils proviennent de moraines disloquées, mais alors ils s'étendent en *nappes* irrégulières, et lorsqu'ils proviennent d'avalanches récentes, ils sont également anguleux, à moins qu'ils ne rencontrent dans leur trajet d'anciennes moraines qu'ils entraînent et avec lesquelles ils se confondent.

Pour se convaincre de l'exactitude de ces faits, il suffit de parcourir la vallée de Chamouni, en suivant les moraines les plus rapprochées des glaciers, ou de s'élever perpendiculairement sur les flancs de la vallée du Rhône entre St. Maurice et Martigny, sur la rive gauche du Rhône, au-dessus de la Pissevache près du hameau

appelée Chaux-Fleurie (Tsau-fria), ou vis-à-vis en montant au village de Morcles depuis les bains de Lavey. Les décombres des dernières débâcles de la Dent du Midi, les grandes avalanches dont on voit partout des traces et les nombreuses digues formées par le Rhône, feront d'ailleurs apprécier justement la différence qu'il y a entre ces divers accidens produits par des causes si différentes.

Les vallées latérales présentent les mêmes phénomènes, comme on peut le voir en remontant le cours de l'Avençon, jusqu'au glacier de Paneyrossaz.

En parcourant ces vallées, je n'ai pas été moins frappé de l'apparence polie que présentent les rochers sur lesquels les glaciers se sont mus; apparence que l'on remarque également dans toutes les vallées dont les flancs sont couronnés d'anciennes moraines, à quelque distance des glaciers actuels qu'elles se trouvent. C'est ainsi que les flancs de la vallée du Rhône sont entièrement polis jusque sur les bords du lac de Genève à plus d'une journée des glaciers, partout où la roche est assez dure pour avoir résisté aux influences atmosphériques.

L'explication que M. de Charpentier a donnée de ces faits, évidemment produits par de grandes masses de glaces, qui remplissaient jadis le fond de toutes les vallées alpines, ne me semble cependant pas embrasser toute la question, et le Jura présente une série de phénomènes qui la mènent plus loin.

Pour mettre plus de liaison dans ce que j'ai à vous dire là-dessus, je vous entretiendrai d'abord des surfaces polies que l'on remarque sur toute la pente méridionale du Jura et que nos montagnards appellent des *laves*, comme nous l'a appris M. Léopold de Buch, celui de tous les géologues qui le premier a le mieux étudié le Jura Neuchâtelois et à qui sont dus les plus grands travaux sur le sujet qui nous occupe.

La pente méridionale du Jura, qui est en face des Alpes, présente de ces *laves* jusque sur ses plus hautes sommités, depuis les bords du lac de Bienne jusqu'au delà d'Orbe; limites dans lesquelles j'ai constaté leur existence.[1] Ce sont des surfaces polies, complètement

[1] Elle s'étendent cependant bien au-delà, comme nous l'apprend une lettre de M. Schimper, reçue le 25 Juillet et insérée à la page 38 de ces Actes.

indépendantes de la stratification des couches et de la direction de la chaîne du Jura; elles s'étendent sur toute la surface du sol, suivant ses ondulations, passant également par dessus le terrain néocomien et le terrain jurassique, pénétrant dans les dépressions qui forment de petites vallées, en s'élevant sur les crêtes les plus isolées et présentant un poli aussi uni que la surface d'un miroir, partout où la roche a été mise récemment à découvert, c'est-à-dire, débarrassée de la terre, du gravier et du sable qui la recouvrent généralement. Ces surfaces sont tantôt planes, tantôt ondulées, souvent même traversées de sillons plus ou moins profonds et sinueux, ou de bosses longitudinales très-arrondies, mais qui ne sont jamais dirigés dans le sens de la pente de la montagne; au contraire, comme les gibbosités, ces sillons sont obliques et longitudinaux; direction qui exclut tout idée d'un courant d'eau comme cause de ces érosions. Un fait très-curieux, que l'on ne saurait non plus concilier avec l'action de l'eau, c'est que ces polis sont uniformes, alors même que la roche se compose de fragmens de différente dureté, et les coquilles qu'elle contient sont tranchées comme dans des plaques de marbre polies artificiellement. On remarque, en outre, sur les surfaces très-bien conservées de fines lignes semblables aux traits que pourrait produire une pointe de diamant sur du verre, et qui suivent en général la direction des sillons obliques. Les localités les plus intéressantes où l'on peut les observer dans les environs de Neuchâtel, sont le Mail, du côté du lac, à la surface du terrain néocomien, et le Plan, à l'endroit où l'ancienne route joint la nouvelle. Les plus remarquables sont cependant à quelque distance de la ville, par exemple, au-dessus du Landeron, à la surface du portlandien sur la lisière des vignes et de la forêt, dans les environs de St. Aubin et au-dessus de Concise. Dans quelques localités on remarque de larges excavations et même des espèces de puits qui ne peuvent avoir été produits que par des cascades tombant entre les fentes de la glace. Pour quiconque a examiné dans les Alpes le fond des anciens glaciers, il est évident que c'est la glace qui a produit ces polis, comme ceux de la vallée du Rhône dont il a déjà été question. Il est digne de remarque que ces polis ne se retrouvent nulle part dans le fond des petites vallées longitudinales formées par les abruptes des dif-

férentes ceintures des couches dont se composent nos chaînes, ni sur l'escarpement même de ceux de ces abruptes qui sont tournés vers la montagne, tandisque j'en ai remarqué sur plusieurs abruptes tournés vers les Alpes, par exemple, le long de la route neuve entre St. Aubin et le château de Vauxmarcus. Il importe également de signaler les différences qui existent entre ces *laves* et d'autres surfaces polies avec lesquelles on ne saurait cependant les confondre, mais qui peuvent leur ressembler dans quelques circonstances. Je veux parler des surfaces polies produites par les failles ou par le glissement des couches les unes sur les autres. Les premières pénétrant verticalement ou obliquement à travers plusieurs couches, ne sont à découvert que là où l'un des côtés de la roche en rupture s'est enfoncé; elles ne sont jamais à découvert sur de grandes surfaces comme les laves; les secondes présentent quelquefois des surfaces assez étendues, lorsque les couches supérieures au glissement ont été enlevées; mais alors les rainures ou les sillons produits par le glissement, sont dans le sens de la pente, ce qui ne se voit nulle part à la surface des laves. Les surfaces polies par l'action des eaux ont également un caractère particulier, soit qu'elles aient été produites par des eaux courantes ou par des masses d'eau plus considérables contenues dans un bassin. Dans le premier cas, ce sont des sillons sinueux descendant toujours, tandisque les sillons et les gibbosités des laves montent et descendent suivant les accidens de la roche polie. Dans le second cas, les eaux mues sur les rivages par les vents, et poussées au-delà de leur niveau habituel, rentrant toujours en équilibre, forment des sillons inégaux plus ou moins profonds, qui suivent généralement la ligne de plus grande pente, à moins que des accidens locaux ne leur donnent une direction particulière. Il en est de même lors de la hausse et de la baisse du lac au printemps et en automne. On peut étudier toutes ces différences dans les environs de la ville, en comparant les surfaces polies *du Mail* avec les érosions produites par le lac dans le prolongement des mêmes couches, ou avec les sinuosités qui ont été produites par le Seyon dans ses gorges. D'ailleurs les surfaces polies par l'action de l'eau ne sont jamais aussi lisses que les laves ou que les surfaces polies par les glaciers. Que l'eau charrie du sable et du limon ou non, les effets sont les mêmes, seulement

ils sont plus lents dans ce dernier cas. Je n'ai pas encore eu occasion d'étudier particulièrement les effets des grandes masses d'eau charriant des glaces ; je ne pense cependant pas qu'elles produisent des effets différens de ceux de l'eau liquide. Ce qu'il y a de certain, c'est que dans les lits de nos rivières et sur les bords de nos lacs ces effets se confondent ; et puis il est évident que la glace flottante ne saurait avoir d'action sur le fond de l'eau qui la porte. Il n'y a donc que les grandes masses de glaces se mouvant immédiatement sur des masses solides qui puissent produire des effets semblables au poli que l'on remarque sur les bords des glaciers en retraite. Ce dernier phénomène est du reste parfaitement semblable à celui que présentent les laves du Jura.

Par cette ressemblance seule on pourrait déjà être porté à penser que des causes semblables ont produit des effets aussi semblables entr'eux. Mais il est d'autres considérations qui nous permettent de lier plus directement ces deux phénomènes, et qui forceront, même ceux qui voudraient y voir des agens différens, à les envisager sous un seul et même point de vue.

Nous avons vu des moraines jusques sur les bords du lac de Genève, sur les deux rives à la même hauteur ; nous avons par-là la certitude qu'il fut un temps où le lac de Genève était gelé jusqu'au fond, et où cette glace s'élevait à une hauteur très-considérable au-dessus de son niveau actuel.

Mais nous savons également que toutes les moraines qui restent en place sont celles que les glaciers laissent sur leurs bords en se retirant. Depuis l'époque donc que je viens de signaler et où les glaciers débouchaient encore dans les vallées inférieures de la Suisse, ils sont allés en diminuant et en se retirant dans des vallées de plus en plus élevées.

Ici une question se présente tout naturellement. Ceux de ces glaciers qui ont eu la plus grande extension, sont-ils descendus du sommet des Alpes? ou bien y aurait-il eu un moment où les glaces se seraient formées naturellement au-delà des limites que nous venons de leur reconnaître, s'étendant peut-être une fois jusqu'au Jura et même au-delà?

Le niveau des moraines des bords du lac Léman, qui sont à 2500 pieds au-dessus de la mer, et la nature des surfaces polies du Jura semblent l'indiquer ; il suffit même de marquer sur une carte de

nivellement les hauteurs des moraines débouchant dans les différentes parties de la chaîne des Alpes, pour se convaincre que les glaces ont une fois recouvert toute la plaine de la Suisse et atteint la pente du Jura.[1]

En effet, la différence de niveau entre l'élévation des moraines des bords du lac de Genève aux environs de Vevey et sur la côte de Savoie, et celle des surfaces polies que l'on observe au-dessus des rivages du lac de Neuchâtel jusque sur le sommet de Chaumont, est telle que la nappe de glace qui remplissait l'espace compris dans ces limites, a pu avoir une certaine inclinaison, puisque le niveau du lac de Neuchâtel n'est que de 1344 pieds au-dessus de la mer, celui de la zône de Pierre-à-Bot, le long de laquelle on trouve le plus grand nombre de blocs, de 2150 pieds ; le sommet même de Chaumont n'a que 3619 pieds.

Cela étant, nous sommes non-seulement en droit d'attribuer à l'action des glaces toutes ces surfaces polies de la pente du Jura, mais encore de les envisager comme un indice assuré de l'étendue plus considérable qu'ont eue les glaces à une époque plus reculée, tant dans le Jura que dans les Alpes.

M. de Charpentier pense que ces glaces étaint des glaciers qui se sont formés sur le sommet des Alpes et qui sont descendus dans la plaine pour s'élever jusqu'à la hauteur où on en trouve des indices, poussant devant eux les blocs qui sont sur le Jura. Mais un fait bien frappant s'oppose à cette explication ; c'est que les blocs du Jura sont généralement moins arrondis et même plus grands que ceux

[1] M. Rod. Blanchet, qui s'est aussi occupé de cette question, a fait dès lors la remarque que le sommet du Pélerin (montagne qui domine Vevey en face de l'ouverture du Valais, élevée de 3301 pieds de France au-dessus de la mer), composé de poudingue à gros grain, est poli sur sa pente, dans un endroit où il n'y a pas d'eau capable de former un petit ruisseau, ni de sentier, ni aucune des causes polissantes que l'on pourrait mettre en avant.

C'est donc à 3300 pieds au moins que l'on peut porter le niveau des glaces qui remplissaient le bassin du lac de Genève, dont la surface n'est maintenant qu'à 1145 pieds. Sur le sommet du Pélerin c'est le *fond* de la grace dont le niveau était de 3300 pieds au-dessus de la mer ; mais rien ne nous indique quelle était son épaisseur dans ce point.

que l'on trouve dans les moraines du bord des glaciers actuels.[1] Si nos blocs avaient été roulés ainsi au bord d'un glacier depuis les Alpes jusqu'au Jura, ils seraient généralement plus ronds, et plus petits, et il y aurait d'immenses moraines adossées au Jura, ce qui n'est pas.[2]

L'opinion généralement reçue attribue le transport de ces blocs à d'immenses courans d'eau ou à des glaces flottantes.

Les plus grandes difficultés que présente cette manière de voir, pour n'en indiquer que quelques-unes, sont d'abord d'expliquer l'origine de ces courans et de la vitesse qu'on doit leur attribuer pour qu'ils aient pu transporter des masses aussi énormes, si toutefois l'on admet qu'ils ont été charriés *après* le soulèvement des Alpes, comme tout semble l'indiquer. Car dans ce cas, ces courans auraient dû partir des *crêtes* qui séparent les vallées, puisque le phénomène des blocs se présente dans toutes les vallées alpines et sur les deux versans de la chaîne, c'est-à-dire que pour suffire aux exigences des faits, ils auraient dû jaillir de toutes ces crêtes[3] avec assez d'impétuosité pour ne plus laisser tomber les blocs au-dessous du niveau où ils se trouvent dans le Jura et dans les vallées alpines où ils n'y a plus de glaciers, puis qu'on nie même encore l'existence

[1] Ces faits ne s'accordent point du tout avec ceux que M. Élie de Beaumont a décrits pour la vallée de la Durance.

[2] Je ne me suis point attaché à décrire la distribution des blocs erratiques sur les pentes du Jura, parce qu'elle est assez connue depuis la publication des recherches de MM. Léop. de Buch, Escher de la Linth, de Luc, sur ce sujet. Je ferai seulement remarquer que leur accumulation sur différens points ne s'accorde pas avec les théories que l'on a avancées pour expliquer leur transport. Ainsi les plus grandes accumulations que j'en connaisse se trouvent à peu de distance l'une de l'autre près du sommet du mont Auber, et dans le fond de Noiraigue, à des niveaux très-différens, et qui ne sont point sur une ligne ascendante dont le sommet serait à Chasseron. Au contraire, c'est en général sur le bord des différens gradins du Jura qu'on en voit le plus, et en particulier sur la lisière que forme tout le long du Jura Neuchâtelois, la dépression des couches supérieures du portlandien, entre le château de la Neuveville, Fontaine-André, Pierre-à-Bot, Troirod, Châtillon, Fresens, Mutruz, etc.

[3] Les systèmes de barrage et de débâcles que l'on pourrait imaginer, n'expliqueraient jamais des faits communs à tant de vallées à la fois.

des grandes moraines, pour attribuer aussi la déposition de ces blocs aux mêmes courans. Mais comment des cours d'eau ayant à peine quelques lieues de long (je parle ici des vallées latérales débouchant dans les vallées principales) auraient-ils maintenu de grands blocs à plus de mille pieds de hauteur? D'ailleurs le fait que les blocs des différentes vallées ne sont pas les mêmes et qu'ils se répandent *en éventail* à une certaine distance des Alpes, exclut cette idée d'une extrême vitesse qu'on a voulu accorder aux courans, uniquement pour expliquer le transport des blocs, sans penser qu'ils auraient dû produire en même temps d'autres effets dont on ne retrouve aucune trace. Ce fait exclut à plus forte raison l'idée d'un grand courant diluvien passant sur toute la Suisse, quelque direction qu'on veuille lui assigner. Si c'est *avant* le soulèvement des Alpes qu'on suppose que le phénomène a eu lieu, je demande comment il se fait que les lignes que ces blocs forment dans les Alpes n'ont pas été disloquées par le soulèvement? car dans ce cas les digues continues et parallèles de blocs que l'on voit *sur les deux flancs* de toutes les vallées alpines et qui en suivent tous les accidens, quelles que soient leur direction et leurs sinuosités, restent inexplicables, l'eau suivant un cours rectiligne dans les différentes anfractuosités du lit qu'elle parcourt, tandis que la glace seule agit avec la même énergie sur tous les points des bassins qu'elle remplit.

Les objections que l'on peut faire contre la théorie des courans sont toutes applicables jusqu'à un certain point à la théorie de M. Lyell, d'un charriage par des glaces flottantes. On peut bien faire arriver par des radeaux de glaces des blocs anguleux jusque sur le Jura; mais les autres particularités de ce grand phénomène ne s'expliquent pas plus par là, qu'à l'aide des courans, dût-on même admettre avec M. Élie de Beaumont que leur eau provenait de la fonte des glaciers.

Une autre objection d'un très-grand poids faite à cette théorie par M. Schimper, c'est l'état actuel des lacs et de la grande vallée suisses. Si les blocs ont été charriés par des courans depuis les Alpes au Jura, ces courans ont naturellement passé par dessus les lacs et les vallées longitudinales et transversales qui se trouvent entre deux. Comment se fait-il alors que ces lacs et ces vallées

n'ont point été comblés? et comment expliquer les escarpemens anguleux de leurs bords?

Quelque violens, quelque rapides, quelque profonds que l'on suppose ces courans, eussent-ils même, contre toutes les lois de la physique, porté des blocs de granit d'environ 50,000 pieds cubes, comme celui de Pierre-à-Bot, ils ont dû se ralentir une fois, et alors les dernières traînées auraient encore dû combler quelques-unes de ces inégalités. Cependant on voit peu de blocs entre les Alpes et le Jura.

Si dans une autre hypothèse on les fait marcher lentement sur des masses de limon et de décombres assez épaisses pour les porter, comment se fait-il que ces masses du moins n'ont pas comblé toutes les inégalités de la Suisse? Les blocs seuls se seraient-ils peut-être déposés après être arrivés sur le Jura, et les masses qui avaient pu les apporter jusques là se seraient-elles alors écoulées pour les laisser en place?

D'autres considérations s'opposent encore à l'admission de tous ces courans.

Les blocs erratiques du Jura reposent partout sur des surfaces polies, à moins qu'ils n'aient été poussés au-delà des crêtes de nos montagnes, et qu'ils ne soient tombés dans le fond des vallées longitudinales, comme on le voit dans toute la vallée du Creux-du-Vent. Mais ce n'est pas *immédiatement* sur les surfaces polies qu'ils sont gisant. Partout où les cailloux roulés qui accompagnent les grands blocs n'ont pas été remaniés par des influences postérieures, on remarque que les petits blocs, des galets de différente grandeur, forment une couche de quelques pouces et quelquefois même de plusieurs pieds, *sur* laquelle les grands blocs anguleux reposent. Ces cailloux sont de plus très-arrondis, même polis et entassés de manière à ce que les plus gros soient dessus les plus petits qui passent souvent à un fin sable au fond, immédiatement sur les surfaces polies. Cet ordre de superposition, qui est constant, s'oppose à toute idée d'un charriage par des courans; car dans ce dernier cas, l'ordre de superposition des cailloux arrondis serait inverse. La présence d'un fin sable à la surface des roches polies, prouve en outre qu'aucune cause puissante n'a agi, ou qu'aucune catastrophe importante n'a atteint la surface du Jura, depuis l'époque du transport de ces roches alpines, ou en d'autres termes, que les

surfaces polies lors du transport des blocs n'ont pas été disloquées depuis. Mais comme ces surfaces forment en grande partie la rive septentrionale des lacs de Neuchâtel et de Bienne, elles prouvent, pour eux du moins, que les lacs suisses existaient déjà; et la continuité des moraines sur les deux rives du lac de Genève, prouve que ce bassin aussi est antérieur au transport des blocs, puisqu'il a précédé la formation des moraines, comme on le verra bientôt.

En considérant la liaison intime des différens faits qui viennent d'être décrits, il est évident que toute explication qui ne rendra pas compte en même temps du poli de la surface du sol, de la superposition et de la forme arrondie des cailloux et du sable qui reposent immédiatement au-dessus des surfaces lisses, et de la forme anguleuse des grands blocs superficiels, est une explication inadmissible pour les blocs erratiques du Jura; et c'est le cas de toutes les hypothèses sur le transport des blocs que je connais.

Voici quelle est l'explication de tous ces phénomènes que je crois maintenant la plus plausible. Elle est le résultat de la combinaison de mes idées et de celles de M. Schimper sur ce sujet. En effleurant plusieurs questions générales qui s'y rattachent, pour chercher à l'établir, je n'ai point l'intention de les traiter à fond maintenant. Je veux simplement faire voir par là que le sujet qui nous occupe touche aux plus grandes questions de la géologie.

L'étude des fossiles porte depuis quelque temps des fruits bien inattendus, surtout depuis qu'elle a pris un caractère physiologique, c'est-à-dire depuis que l'on a entrevu qu'il existe un développement progressif dans l'ensemble des êtres organisés qui ont vécu sur la terre, et que l'on a reconnu des époques de renouvellement dans leur ensemble. Ceux qui ont compris ce progrès ne doivent pas craindre maintenant d'en poursuivre les conséquences jusques dans leurs dernières limites, et l'idée d'une diminution uniforme et constante de la température de la terre, telle qu'elle est admise, est tellement contraire à toute notion physiologique, qu'il faut la repousser hautement pour faire place à celle d'une diminution de température accidentée en rapport avec le développement des êtres organisés qui ont paru et disparu les uns à la suite des autres à des époques déterminées, se maintenant à une moyenne particulière pendant une époque donnée, et diminuant à des époques fixes.

Comme le développement de la vie individuelle est toujours accompagné de celui de la chaleur, que sa durée établit un certain équilibre plus ou moins durable, et que sa fin produit un froid glacial, je ne crois donc pas sortir des conséquences que les faits permettent de déduire, en admettant que sur la terre les choses se sont passées de la même manière : que la terre, en se formant, a acquis une certaine température très-élevée, qui est allée en diminuant à travers les différentes formations géologiques ; que pendant la durée de chacune d'elles, la température n'a pas été plus variable que celle de notre globe depuis qu'il est habité par les êtres qui s'y trouvent, mais que c'est aux époques de disparition, de ses habitans qu'a eu lieu la chute de la température, et que cette chute a été au-dessous de la température qui signale l'époque suivante et qui s'est relevée avec le développement des êtres apparaissant nouvellement.

Si cette manière de voir est vraie, et la facilité avec laquelle elle explique tant de phénomènes inexplicables jusqu'ici me fait penser qu'elle l'est ; si cette manière de voir, dis-je, est vraie, il faut qu'il y ait eu à l'époque qui a précédé le soulèvement des Alpes et l'apparition des êtres vivant maintenant, une chute de la température bien au-dessous de ce qu'elle est de nos jours. Et c'est à cette chute de la température qu'il faut attribuer la formation des immenses masses de glace qui ont dû recouvrir la terre partout où l'on trouve des blocs erratiques avec des roches polies comme les nôtres. C'est sans doute aussi ce grand froid qui a enseveli les Mammouths de Sibérie dans les glaces, congelé tous nos lacs, et entassé de la glace jusqu'au niveau des faîtes de notre Jura qui existaient avant le soulèvement des Alpes.

Cette accumulation de glace au-dessus de tous les bassins hydrographiques de la Suisse se conçoit aisément quand on pense que les lacs une fois gelés jusqu'au niveau de leurs débouchés, les eaux courantes ne s'écoulant plus, et celles du ciel accrues par les vapeurs des régions méridionales qui, dans des circonstances pareilles devaient se précipiter abondamment vers le Nord, en ont rapidement augmenté l'étendue et rehaussé le niveau jusqu'à la hauteur qui a été constatée par les faits déjà énoncés. L'hiver de la Sibérie s'était établi pour un temps sur une terre jadis couverte d'une riche végétation et peuplée de grands mammifères, dont les semblables

habitent de nos jours les chaudes régions de l'Inde et de l'Afrique. La mort avait enveloppé toute la nature dans un linceul, et le froid arrivé à son plus haut degré, donnait à cette masse de glace, au maximum de tension, la plus grande dureté qu'elle puisse acquérir. Lorsqu'on a été fréquemment témoin de la congélation d'un lac, on sait combien la glace est résistante dans cet état, et à quelle immense distance des corps durs jetés à sa surface peuvent y glisser par suite même d'une faible impulsion.

L'apparition des Alpes, résultat du plus grand des cataclysmes qui ont modifié le relief de notre terre, a donc trouvé sa surface couverte de glace, au moins depuis le pôle Nord, jusque vers les bords de la Méditerrannée et de la mer Caspienne. Ce soulèvement, en rehaussant, brisant, fendillant de mille manières les roches dont se compose le massif qui forme maintenant les Alpes, a également soulevé les glaces qui le recouvraient; et les débris détachés de tant de fractures et de ruptures profondes se répandant naturellement sur la surface inclinée de la masse de glace appuyée contre elles, ont glissé sur sa pente jusqu'aux points où ils se sont arrêtés, sans s'arrondir, puis qu'ils n'éprouvaient aucun frottement les uns contre les autres et qu'en se heurtant ils se repoussaient facilement sur une pente aussi lisse; ou bien, après s'être arrêtés, ils ont été portés jusques sur les bords ou dans les fentes de cette grande nappe de glace, par l'action particulière et les mouvemens propres à l'eau congelée, lorsqu'elle subit les effets des changemens de température, de la même manière que les blocs de rocher tombés sur des glaciers sont poussés sur leurs bords, par suite des mouvemens continuels qu'éprouve leur glace en se ramollissant et en se congelant alternativement aux différentes heures de la journée et dans les différentes saisons. Ces effets devraient être décrits en détail, mais comme ils sont en partie connus, je ne m'y arrête pas.[1] Je me borne à dire que la puissance d'action qui en résulte pour la glace est immense; car ces masses se mouvant continuellement sur elles-mêmes et sur le sol, broient et arrondissent tout ce qui y est mobile, et polissent les surfaces solides sur lesquelles elles reposent, en même temps

[1] M. Schimper a fait un beau travail sur les effets de la glace, auquel je renverrais mes lecteurs s'il était publié.

que leurs bords poussent devant eux tout ce qu'ils rencontrent, avec une force irrésistible. C'est à ces mouvemens qu'il faut attribuer la superposition étrange des cailloux roulés et du sable, qui reposent immédiatement sur les surfaces polies ; et c'est sans doute à la pression de ce sable sur les surfaces polies que sont dues les fines lignes qui s'y trouvent gravées, et qui n'existeraient pas si le sable avait été mu par un courant d'eau : car ni nos torrens, ni l'eau fortement agitée de nos lacs, ne produisent rien de semblables sur les mêmes roches. Quant à la direction longitudinale de ces fines lignes et des sillons que l'on remarque sur les surfaces polies, je ferai observer qu'elle a dû résulter de la plus grande facilité que devait avoir la glace à se dilater dans le sens de la grande vallée suisse, plutôt que transversalement, encaissée comme elle l'était entre le Jura et les Alpes ; ce phénomène n'ayant dû commencer qu'avec le retrait de la glace, à une époque où les Alpes étaient déjà debout. Je ne mets pas en doute, que la plupart des phénomènes attribués à de grands courans diluviens, et en particulier ceux que M. Seefström a fait connaître récemment, n'aient été produits par les glaces.

Lors du soulèvement des Alpes, la surface de la terre s'est réchauffée de nouveau, et la chaleur dégagée de toutes parts a dès-lors commencé à faire fondre ces masses de glaces, qui se sont successivement retirées jusques dans leurs limites actuelles. Des crevasses se sont formées d'abord dans les endroits où la glace était le plus mince, c'est-à-dire sur le sommet des montagnes et des collines qui en étaient recouvertes, puis le long des points les plus saillans de la plaine : des vallées d'érosion ont alors été creusées au fond de ces crevasses, dans des localités où aucun courant d'eau ne pourrait couler sans être encaissé dans des parois congelées ; et quand la glace eut complètement disparu, les grands blocs anguleux qui couvraient sa surface, ou qui étaient tombés dans ses fentes, se sont trouvés sur un lit de petits cailloux arrondis, sous lesquels on trouve encore ordinairement un sable plus fin. En baissant de niveau, la glace a nécessairement dû occuper plus longtemps les dépressions du sol, les petites vallées longitudinales formées par les différentes ceintures des couches du Jura et le fond des lacs ; et c'est sans doute à ce fait qu'il faut attribuer la position bizarre de tant de blocs perchés à peine en équilibre sur les pointes les plus éminentes des rochers, et

leur absence constante dans les enfoncemens, où on n'en trouve du moins que là où de nouvelles dilatations momentanées de la glace en retraite a pu les y précipiter.

Aussi longtemps que le niveau des glaces dans le Jura ne fut pas tombé au-dessous de la ligne de Pierre-à-Bot, les blocs qui étaient encore répandus sur toute sa surface, purent continuer à être poussés contre le Jura; mais bientôt après les glaces devenant fort minces sur toute la plaine suisse, durent en disparaître promptement et ne plus laisser que des taches dans les vallées profondes et dans les bassins des lacs, c'est-à-dire, qu'elles se trouvèrent bientôt resserrées dans les vallées inférieures des Alpes.

En réfléchissant à ce qui a dû se passer pendant cette retraite des glaces, on est naturellement porté à penser que le transport des cailloux roulés de la vallée du Rhin et la déposition du Löss en ont été un des premiers effets, d'autant plus que ces cailloux sont les mêmes que ceux qui se trouvent avec nos blocs, et que le Löss est évidemment le résultat du détritus de la molasse. De fréquentes débâcles ont pu alors seulement charrier aussi des blocs sur des radeaux de glaces à de très-grandes distances, ou même en entraîner quelques-uns plus loin dans leur courant.

La fonte et la macération des glaces et leur congélation réitérée dans les jours froids, ont produit beaucoup d'autres effets géologiques difficiles à expliquer par d'autres causes. Sans rappeler les vallées d'érosion, je pourrais citer ces sillons profonds qui ne sont pas des fissures et qui sont dominés par de grandes étendues de plaines; ou bien ces petits lacs qui se forment quelquefois sur le bord des glaciers, et qui remanient les roches menues accumulées sur leurs bords, de manière à leur donner une apparence stratifiée; ou bien les phénomènes analogues que l'on observe sur les limites des différentes stations où les grandes nappes de glace ont dû s'arrêter successivement dans leurs retraites, ou bien la dispersion des os des mammifères de l'époque diluvienne, sans qu'ils soient ni roulés, ni brisés, etc., ou encore une foule d'autres particularités qui ne peuvent avoir d'intérêt que lorsqu'on a embrassé l'ensemble de la question.

Dès ce moment la surface de la terre a dû être soumise de nouveau aux influences du cours régulier des saisons; ce fut alors le premier

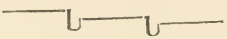
printemps des animaux et des plantes qui vivent de nos jours ; les glaces s'étaient retirées jusqu'aux pieds des Alpes, du sommet desquelles il commençait à leur venir de nouveaux renforts. Mais bientôt elles subirent leurs dernières retraites en oscillant toujours, gagnant tantôt en étendue et poussant des blocs devant elles, tantôt se retirant dans des limites de plus en plus étroites. À chaque pied de terrain qu'elles abandonnaient, elles laissaient derrière elles, comme les glaciers actuels en retraite, quelques-unes de ces longues digues de blocs qui dominent encore les vallées alpines. Bientôt les lacs se dégelèrent aussi, les eaux prirent leur cours actuel, les vallées des Alpes furent balayées, et il ne resta plus de glace des frimats passés que sur les sommets de nos blanches montagnes.

Ce serait donc une grave erreur de confondre les glaciers qui descendent du sommet des Alpes, avec les phénomènes de l'époque des grandes glaces qui ont précédé leur existence.

Le phénomène de la dispersion des blocs erratiques ne doit donc plus être envisagé que comme un des accidens qui ont accompagné les vastes changemens occasionnés par la chute de la température de notre globe avant le commencement de notre époque.

Admettre une époque d'un froid assez intense pour recouvrir toute la terre à de très-grandes distances des pôles d'une masse de glace aussi considérable que celle dont je viens de parler, est une supposition qui paraît en contradiction directe avec les faits si connus qui démontrent un refroidissement considérable de la terre depuis les temps les plus reculés. Rien cependant ne nous a prouvé jusqu'ici que ce refroidissement ait été continuel, et qu'il se soit opéré sans oscillations ; au contraire, quiconque a l'habitude d'étudier la nature sous un point de vue physiologique, sera bien plus disposé à admettre que la température de la terre s'est maintenue sans oscillations considérables à un certain degré, pendant toute la durée d'une époque géologique, comme cela a lieu pendant notre époque, puis qu'elle a diminuée subitement et considérablement à la fin de chaque époque, avec la disparition des êtres organisés qui la caractérisent, pour se relever avec l'apparition d'une nouvelle création au commencement de l'époque suivante, bien qu'à un degré inférieur à la température moyenne de l'époque précédente ; en sorte que la

diminution de la température du globe pourrait être exprimée par la ligne suivante :



Ainsi l'époque de grand froid qui a précédé la création actuelle, n'a été qu'une oscillation passagère de la température du globe, plus considérable que les refroidissemens séculaires auxquels les vallées de nos Alpes sont sujettes. Elle a accompagné la disparition des animaux de l'époque diluvienne des géologues, comme les Mammouths de Sibérie l'attestent encore, et précédé le soulèvement des Alpes et l'apparition des êtres vivans de nos jours, comme le prouvent les moraines et la présence des poissons dans nos lacs. Il y a donc scission complète entre la création actuelle et celles qui l'ont précédée ; et si les espèces vivantes ressemblent quelquefois à s'y méprendre à celles qui sont enfouies dans les entrailles de la terre, on ne saurait cependant affirmer qu'elles en descendent directement par voie de progéniture, ou, ce qui est la même chose, que ce sont des espèces identiques.

Partant de ce qui précède, on parviendra aussi un jour à déterminer quelle est l'époque géologique à laquelle le soleil a commencé à exercer une influence assez considérable sur la surface de la terre, pour y produire les différences qui existent entre ses zônes, sans que ces effets fussent neutralisés par l'action de la chaleur intérieure, à laquelle la terre a dû pour un temps une température très-uniforme sur toute sa surface.

Cette manière de voir, je le crains, ne sera pas partagée par un grande nombre de nos géologues qui ont sur ce sujet des opinions arrêtées ; mais il en sera de cette question comme de toutes celles qui viennent heurter des idées reçues depuis longtemps. Quelque opposition qu'on puisse lui faire, toujours est-il que les nombreux faits nouveaux relatifs au transport des blocs que je viens de signaler, et que l'on peut étudier si facilement dans la vallée du Rhône et aux environs de Neuchâtel, ont amené la question sur un autre terrain que celui sur lequel elle a été débattue jusqu'à présent.

Quand M. de Buch affirma pour la première fois, en face de l'école formidable de Werner, que le granit est d'origine plutonique,

et que les montagnes se sont élevées, que diront les Neptunistes? — Il fut d'abord seul à soutenir sa thèse, et ce n'est qu'en la défendant avec la conviction du génie qu'il l'a fait prévaloir. Heureusement que dans les questions scientifiques, les majorités numériques n'ont jamais décidé de prime abord aucune question.

La forme que j'ai donnée aux observations que je viens de présenter, éloignera, je l'espère, d'ici toute discussion sur ce sujet, à moins qu'on ne réclame qu'il en soit autrement. Cependant, comme je ne saurais espérer d'avoir convaincu de la vérité de ces vues ceux qui viennent de les entendre pour la première fois, je pense que la section de Géologie sera la réunion la plus convenable pour discuter ces questions, s'il y a lieu. Là je me ferai un devoir de répondre à toutes les objections que l'on voudra bien me faire, et que je sollicite même vivement dans l'intérêt de la vérité.

P.S. Cette exposition a été accompagnée de démonstrations graphiques qui ne peuvent être reproduites ici, mais que je publierai ailleurs. — They are placed at the end of the Atlas accompanying "Études sur les glaciers," published three years later, as plates 15, 16, 17, and 18, Neuchâtel, 1840.

CHAPTER VI.

1836–1837 (*continued*) and 1838.

Discussion raised by Agassiz's Discourse at Neuchâtel — Agassiz's Great Reputation at the Early Age of Thirty Years — Death of his Father — Laurillard the Assistant of Cuvier — The Establishment of Hercule Nicolet's Lithography at Neuchâtel — Dr. Vogt of Berne sends Agassiz Edward Desor as a Secretary — Offer of a Chair at the Academies of Geneva and Lausanne — First Visit to the Bernese Alps — Two Letters to Jules Thurmann — A Visit to Chamounix — The Meeting of the Geological Society of France at Porrentruy — First Use of Lithochromy for the Plates of Fossil Fishes — The Geologist Armand Gressly — Agassiz created a "Bourgeois" of Neuchâtel — Organization of an Academy at Neuchâtel.

The general impression, after the address was delivered, was astonishment mingled with much incredulity. It was like a pistol shot fired into the midst of the assembly. The majority were at first disagreeably impressed by this disturbance of the peace. Von Buch particularly was horrified, and with his hands raised towards the sky, and his head bowed to the distant Bernese Alps, exclaimed: —

"*O Sancte de Saussure, ora pro nobis!*"

In general, almost all the practical stratigraphists present were either opposed to it or indifferent. Even

de Charpentier was not gratified to see his glacial question mixed up with rather uncalled-for biological problems, the connection of which with the glacial age was more than problematic.

The first part of the address presented in a clear way all the facts first observed by Venetz and de Charpentier, with additional observations made by Agassiz on the Jura in the vicinity of Orbe, Neuchâtel, and Bienne. The only opinion expressed by Agassiz which was opposed to de Charpentier's glacial theory, that the ice covering all the country as far as the Jura did not come from glaciers of the Alps, was an error on his part. The second part presented by Agassiz, a combination of his ideas with those of Schimper, was fully as erroneous as the theory of water and mud currents defended by de Luc, von Buch, and Élie de Beaumont. It is not surprising that de Charpentier shook his head and was sorry to see his glacial theory used as a vehicle for such biological dreams and fantastic explanations of the "rôle" played by the upheaval of the Alps. The only rational and just conception presented in the second part is, that immense masses of ice covered the earth wherever boulders and polished rocks exist, and that the earth was covered by ice at least from the north pole to the Mediterranean and Caspian seas; in a word, that there was an "Ice-age," or "Eiszeit," according to the name coined by Schimper.

The idea of an Ice-age was a stroke of genius due to Agassiz;[1] Schimper tried to explain it by means of

[1] Many years after, when the question of an Ice-age had been recognized as settled according to the views of Agassiz, I received a letter from

biological phenomena, which according to his views were the causes of the fall of temperature (*la chute de la température*). Schimper exhibits a curious combination of a dreaming philosophy and mathematical spirit with a great deal of poetical inspiration, — a most attractive man. From the first he made use of mathematical drawings in his explanations of the morphology and phyllotaxy of plants; and during his stay at Neuchâtel in 1837, he constructed, with the help of Agassiz, a synoptical table, showing the disposition, the history, and classification of the animal kingdom, which has since been published under the title of "Crust of the Earth as related to Zoölogy," as a frontispiece to "Principles of Zoölogy," by Agassiz and Gould, Boston, 1848. Shortly after, during the same year, Schimper constructed a table showing the different systems of upheaval, as imagined by Élie de Beaumont, by means of concentric circles, with a wheel in the centre showing the directions. Applying his mathematical bent to the fall of the temperature due, according to him, to the complete extinction of life at the end of each geological period, he drew the little figure which was inserted by Agassiz in his address.

Two features characteristic of the style of this celebrated discourse must occur with force to any

him, dated Cambridge, March 13, 1868, in which he said: "Ce n'était pas petite chose de se poser en adversaire de Léopold de Buch, en 1837, et d'avoir conquis sur ce sujet l'assentiment de tous les géologues, à l'exception d'Élie de Beaumont; car l'an dernier Murchison lui-même m'écrivait qu'il se rendait enfin à l'évidence. Vous savez que la part de Charpentier se réduit à avoir démontré la grande extension du glacier du Rhône. C'est moi qui ai posé la question d'une époque glaciaire et qui l'ai fait prévaloir."

reader who is a French scholar. First, it is astonishing to see so great a number of words italicized. In no one of his papers, before or since, did Agassiz use this mode of attracting attention to special points. It shows how excited he was, and how desirous to impress on his listeners and readers several points, considered by him of paramount importance in the glacial question. As a rule, Agassiz shunned such a way of securing attention. He was a good writer, and made excellent use of French, which remained his favourite language until the end of his life. However, it is easy to detect in this address of Neuchâtel a certain number of Germanisms, due to his long residences in southern Germany.

Discussions of great earnestness followed, in which all the naturalists present joined; and although Agassiz displayed a rare talent for exposition, he succeeded only in attracting attention to the practical part of his address. With his keen eyes, he immediately perceived the bad impression made by his theoretical views, and if he did not drop them at once, it was only because it was so hard for him to admit a mistake; having once proclaimed his views and opinions on any subject, he was always most persistent in maintaining them. However, in this case he recalls his theory only once, at the end of his volume "Études sur les glaciers," p. 328, 1840, and never mentions it again in any of his papers or addresses.

Élie de Beaumont, who arrived the day after the meeting was over, joined von Buch in his opposition, and the two, with their Italian friend, de Collegno, were much excited and painfully affected. Von Buch, who

was before very favourable to Agassiz, became an opponent, and there is no doubt that Agassiz's very fair prospect of an offer of a professorship at the Berlin University was absolutely ruined from that day.

The great value of Agassiz's address lies in his more graphic description of the action of glaciers on rocks, than that given before by de Charpentier, in his paper of 1834, and in the idea of the universality of the glacial action over half a hemisphere. Besides, it drew attention more vividly to the question, and in a way which obliged every one opposed to the view of glacial action to give his reasons.

There is no other example of such a rapid rise to great scientific reputation as Agassiz enjoyed in his thirtieth year. At the age of twenty-one, when he was still a student, he laid the foundation by his publication in 1828 of Spix's Brazilian fishes; and the first numbers or "livraisons" of his "Fossil Fishes" attracted the attention of naturalists the world over. Everything he published from 1828 to 1837 is remarkable, showing a rare power of description and classification, and a facility in handling the most difficult problem of natural history. His memoirs are entirely his own work, except the illustrations; and any one who reads them will see a difference between them and similar work produced after 1837. His power of classifying fossils and his success in reducing to order thousands of specimens of fishes, a great many of which were perfect puzzles to every one, were simply marvellous; and he worked at his herculean task as no man but a man of genius could have done.

Up to that time, he had worked entirely alone. The only collaboration he had ever had was in his Neuchâtel address before the Swiss naturalists, when he combined, as he said, his views with those of Karl Schimper, on the explanation of the great ice covering, which, according to his view, had extended from the north pole as far at least as the Mediterranean Sea. It was not a success, as he had occasion at once to see before the meeting was adjourned; for "Schimperizing" — as it was familiarly called among Agassiz's friends — was anything but congenial to his audience. It is true that he abandoned, little by little, all the ideas put forward so boldly and rashly, retaining only the word "Ice-period" (*Eisnetz*); and he returned quietly to the teaching he had received so liberally from de Charpentier and Venetz. But the difficulties which arose from this collaboration, and which broke out soon after, as we shall see, were a hint that collaboration was not suited to him, and a warning to him to be on his guard in future against scientific help and associates. Instead of heeding the warning, Agassiz, on the contrary, from that time until almost the end of his life, accepted collaboration of some sort, and entered into a succession of very serious difficulties, from which he was never able entirely to extricate himself, falling from one into another, and suffering greatly through his own fault.

It is pleasant to say that until 1837 Agassiz had really committed no fault of any consequence. At the early age of thirty years he had attained the zenith of his reputation, entirely by his own exertion and his unaided works. The address of 1837, on the glacial ques-

tion, may be considered as the climax of his scientific life, as far as originality of research is concerned: it was his apogee. It is not that Agassiz's publications since that time are devoid of originality; not by any means. But after 1837 he always made too much use of others in the work of writing and too often of observation; and it is easy to detect the lack of unity, and at the same time the inequality of value in all his publications after 1837. To be sure, Agassiz published a great deal more after 1837 than he did before, but the quantity did not compensate for the quality.

His good father — a true, practical, and business man — died a few weeks after the meeting of the Swiss naturalists at Neuchâtel. He much enjoyed seeing his son, still so young, the president of an assembly of savants collected not only from all the cantons of Switzerland, but even from Berlin, Paris, Strasbourg, and Frankfort. Rodolphe Benjamin Louis Agassiz was born the 3d of March, 1776, and died on the 6th of September, 1837, at Concise, in the parsonage of that beautiful village, at the age of sixty-one years. We may say of him, what we said previously of Cuvier: had he lived ten years longer, it would have been to the advantage of Louis, who so much needed good advice and restraint in his already too great expenses.

During his stay in Paris, in 1832, Agassiz was the witness of the great help afforded to Cuvier by his principal assistant naturalist, M. Charles L. Laurillard. In the laboratory, in his library, or in his cabinet, Cuvier always found everything in perfect order, and ready for the special work he was engaged in. Lau-

rillard, born at Montbéliard, like Cuvier, possessed a great heart, a rare modesty, profound knowledge of many questions of natural history, was devoted body and soul to his great master, and was completely devoid of any ambition, except to receive and always deserve the approbation of Cuvier. Ever since that time, Agassiz's ambition had been to get, as soon as his means would allow it, his own Laurillard. He tried again and again, and always failed. It is true that men like Laurillard are very rare; but Agassiz never possessed the art of properly managing his assistants; an art which Cuvier always had. Cuvier treated Laurillard with dignity, never with familiarity, much less in a spirit of comradery and companionship. From the first day of the arrival of Laurillard in the laboratory of Cuvier, he received a regular salary. He often accompanied Cuvier in his journeys; but he had the great tact to remain in his subordinate position of assistant, taking care to keep himself always in the background.

With Agassiz it was very different; he never knew how to keep his assistants at a distance. They very soon became intimate with him, or were allowed privileges not proper to their subordinate position. In addition, the question of compensation was a constant difficulty, either through the lack of complete understanding, or through the small amount of the salaries. In a word, Agassiz was a very bad manager of men, while Cuvier, on the contrary, was a capital and rare director of everything relating to scientific work and scientific assistants. Years after the death of Cuvier, I

have heard Laurillard speak of him with the same respect as if Cuvier had been in the room. With Agassiz, all his assistants became so familiar and so much on an equality, as to raise the question who was truly the master and director.

Finding constant difficulties in regard to the execution and correction of the plates for his "Poissons fossiles," it was natural that Agassiz should desire to have a good lithography established at Neuchâtel. But such an establishment in so small a town as Neuchâtel then was, was a very hazardous undertaking; for it was certain from the beginning that the only customer of any consequence for a great lithography would be Agassiz, and, with his small salary, although raised from $400 to $600, it was almost an act of folly to establish a lithography; more especially since he was also obliged to pay for all his printing. The man chosen was a Neuchâtelois from La-Chaux-de-Fond, named Hercule Nicolet; a good lithographer, or artist rather, but as devoid of business capacities as Agassiz. The lithography was established at the end of 1836, aux Sablons, above the city of Neuchâtel, just at the place where the railroad station now stands. The establishment soon increased, about twenty persons being employed there, and turned out perfect work. But, from the beginning, it was evident that other publications with plates, besides the "Poissons fossiles," the "Echinodermes," and the "Poissons d'eau douce," must be undertaken to keep such a large establishment in work. And Agassiz, unpractical as he was, resolved to publish a German and French edition of "Sowerby's Mineral Conchology of

Great Britain," a very expensive work. The first part, or "livraison" is entitled, "Sowerby-Mineral-Conchologie Grossbritanniens; deutsche Bearbeitung, herausgegeben von H. Nicolet, durchgesehen von Dr. Agassiz," and was offered by the editor to the library of the Helvetic Society of Naturalists, at the meeting of July, 1837, at Neuchâtel.

Perceiving that he had too many irons in the fire, Agassiz longed for a secretary; and, in a visit to Berne, during the fall of 1837, he asked Dr. Vogt, the father of Karl Vogt, if he knew any young man able to write well, with some knowledge of natural history, and acquainted with the French language, because his publications must be in that language. And he added, "If you can find for me somebody of that sort, Papa Vogt, I shall bless the day which has brought me here." Karl Vogt, then a young university student, who was present at the visit of Agassiz, and has recalled the whole conversation in his biography of Edward Desor, says, "Desor had gone to Hofwyl to offer his services at the great educational establishment of von Fellenberg,[1] with the hope of being accepted. But after two days passed there, he returned to Berne absolutely crushed by his failure to obtain a position, having received the discouraging answer from Herr Fellenberg

[1] The Hofwyl College, placed by von Fellenberg in his chateau, was a philanthropic institution created as a normal school of agriculture and a model farm. There was besides a great school for secondary and superior education. It was very expensive to von Fellenberg, who was obliged to appoint too many professors of an inferior quality and who were poorly paid, and who did not stay long. They were recruited mainly in Germany among students who had just left universities.

that all the places he was able to dispose of had been already filled." The house of Dr. Vogt was a sort of refuge, always open to all German political refugees, as Desor was. At supper Dr. Vogt said, "What do you think, Desor, of going to-morrow to Neuchâtel where Agassiz is now; he wants a secretary. It seems to me that it may be a good thing for you. I will give you a few lines of introduction to him." At those words Desor jumped with joy, and, next morning, started on foot. He arrived a day later at Neuchâtel, and with his traveller's stick in his hand, a cap on his head, a gray blouse on his back, and very few pennies in his pocket, called at Agassiz's apartment and delivered the letter of introduction and recommendation of Dr. Vogt. He was accepted by Agassiz, but without any regular pay. Agassiz gave him a room in his own apartment, and paid his board at Professor Ladame's "table de pension," and as to pecuniary remuneration, it was simply understood that when he wanted money, if Agassiz had any, he would give him some; if Agassiz had none, he would have to wait until Agassiz's purse was replenished in some way. As Karl Vogt says, "When Agassiz had money, he gave what was wanted," — a singularly unbusiness-like arrangement.

P. J. Édouard Desor, born February, 1811, near Frankfort, was a law student at the University of Heidelberg, when a revolution took place in southern Germany, about 1832, in which he participated, like many other students; and he was obliged to fly to France for safety, and went to Paris, where he lived four years in poverty, giving a few lessons as a private

teacher, and helping in the translation into French, and in collaboration with E. Duret, of one volume of Karl Ritter's Geography on Africa, and of a small memoir by A. de Klipstein and J. J. Kaup on the *Dinotherium giganteum*. His knowledge of natural history was very limited, and consisted only of what any student who followed lectures at Heidelberg and Paris would pick up. He had studied law, and had received no proper education to become a naturalist. He offered himself at the Hofwyl Institut, near Berthoud, directed by the celebrated Fellenberg, as a teacher of modern languages, more especially of French, for which he had fitted himself during his four years' stay in Paris. Agassiz saw at once that his natural history knowledge was most elementary; but as he was able to make good translations into French and German, and was intelligent and ready to undertake anything to get his living, Agassiz engaged him.

It must not be supposed that Desor was taken by Agassiz as collaborator and assistant in natural history. He was taken only as a secretary; for, as we have said, until then the natural sciences were almost completely unknown to him. His only duties at first were to write letters under Agassiz's dictation, to keep the accounts, to oversee what was going on at the lithography and at the printing-press. During the first two years of his stay at Neuchâtel, he took only the scientific title of *geographer*. But he followed Agassiz's public lectures, and quickly apprehended everything said by Agassiz, learning natural history with great facility. He had a good memory, and was a hard worker, — "infatigable,"

as Vogt says. In fact, Desor entered Agassiz's house, with the smallest possible amount of natural history knowledge; and in two years he became a tolerably good assistant in natural history, being the best pupil Agassiz had during his stay in Europe.

It is important to remark that at the time of Desor's arrival at Neuchâtel as Agassiz's secretary, nine parts, or "livraisons," of the eighteen composing the whole work of "Les Poissons fossiles," had already been issued; that is, half of the work had been published. The tenth "livraison" was on the point of being distributed, and was officially issued at the beginning of 1838. Eight plates of echinoderms, for the "Echinodermes fossiles de la Suisse," were already printed, as well as a certain number of plates of "Trigonia" and "Mya."

As soon as he was established in Agassiz's house, Desor was put at work on the translation into German and into French of Sowerby's great work on the fossils of Great Britain, and afterward at the translation into German of Buckland's Bridgewater Treatise on Geology, all of which were almost useless, not one ever having paid the expenses of printing and lithography. If Agassiz had had millions at his disposal, it would have been very well; but even then he might have used the money with more profit to science. For if up to this time Agassiz had experienced great difficulties and stringency in money matters in keeping his two draughtsmen, and publishing his "Poissons fossiles," he had at least succeeded in keeping free of heavy debts. His new undertakings were regarded with

apprehension by all his family and his best friends. But it was useless to oppose Agassiz; he would listen to nothing and to no one. Science was paramount with him; everything else was of little consequence. He was born to give great impetus to natural history; and all his life he was absolutely devoted to it. Desor saw this very quickly, and took advantage of it. Science and friends working in the same field were everything. "Agassiz et ses amis," or "Agassiz et ses compagnons de voyages," became supreme. It was an unfortunate day for the future of Agassiz when Desor entered his service. From that time until he left Neuchâtel, in 1846, during nine years, expenses increased, until a complete collapse came as the inevitable consequence. Instead of being encouraged to expend more and more, Agassiz, on the contrary, ought to have been constantly restrained, on account of his too great propensity to throw money in all directions, even when it was not absolutely necessary. It was difficult to stop him, it is true; but repeated representations, accompanied by the warnings constantly poured into his ears by all the members of his family, Alexander Braun included, and all his best friends, might have resulted in restriction instead of constant expansion.

The Academy of Lausanne, after conferring on Agassiz the title of honorary professor, offered him, in 1838, a chair of active professor. Pressure was exerted by some of Agassiz's kindred, all Vaudois, — for the Canton de Vaud is the true *patria* (fatherland) of the Agassiz, — but in vain. He had cast in his lot with Neu-

châtel, and remained faithful to the place which first gave him an official position. To reward his attachment, the citizens of his adopted city wrote him a letter of thanks, announcing at the same time that his salary had been increased by 2000 francs ($400) for three years. A few weeks before the offer of the Lausanne Academy was made, Agassiz was approached by the already celebrated physician, Auguste de la Rive, on the subject of a chair at the Geneva Academy. In a letter dated May, 1838, de la Rive stated frankly how the matter stood; and that he himself and everybody at Geneva thought that Agassiz was the one indispensable man. But Agassiz was already too strongly bound by his lithographic establishment and printing works to break his connection with Neuchâtel; at least, he thought so, and declined the friendly offers of de la Rive. It was doubtless a mistake; for Geneva would have given him more support and income than he was able to get at Neuchâtel. As de la Rive told him, "at Geneva you would be a second de Saussure."

After a short journey to Paris, during July, 1838, in connection with his work on the "Poissons fossiles," and to examine more carefully than he had done before the method of the laboratory at the Jardin des Plantes for moulding fossil animals, he started for the Hassli in the Oberland of Berne, studying carefully all glacial marks round the village of Guttannen, the Handeck, at the Grimsel, and at the glacier of Rosenlaui. Agassiz took with him five persons, making a party of six, — his brother-in-law Max Braun, a mining engineer just re-

turned from Algeria, his draughtsman Dinkel, who had returned from his three years' stay in England, his secretary Desor, and two students or amateurs of glaciers and high alpine region.

It was Agassiz's first excursion to the Bernese Alps, and everything enchanted him; from Thun to Interlaken, Meyringen, and Helleplatte, where the granite is so finely polished and striated by old glaciers that it looks like polished marble. Dinkel made an exact drawing of it, which was published afterward by Agassiz in the beautiful atlas accompanying his "Études sur les glaciers." Agassiz was particularly impressed by the Grimsel and its environs, and at this time made his first visit to the glacier of the Aar, which afterward became his great station for glacial observations. The excursion lasted only ten days, and they were again at Neuchâtel on the 24th of August.

The following letter addressed to the great Jurassic geologist, Thurmann, on the occasion of the approaching meeting of the Geological Society of France in Switzerland, is interesting; for it was written on the same day he returned from the Oberland.

NEUCHÂTEL, le 24 août, 1838.

MONSIEUR JULES THURMANN,
à Porrentruy.

Monsieur, — J'arrive en ce moment à Neuchâtel d'une tournée dans les Alpes bernoises, où j'étais allé inspecter cette partie de la série de nos glaciers, désirant remettre sur le tapis la question des roches polies, des moraines, des blocs erratiques, etc., qui est si évidente et sur laquelle la plupart de nos géologues ont si peu de

faits à leur connoissance. Tout ce que j'ai énoncé précédemment sur cette grave question se trouve confirmé sur un nouveau terrain où j'ai même rencontré un collaborateur intelligent, avec lequel je n'ai pas eu de peine à m'entendre, car *il avait vu* (ce collaborateur était Arnold Guyot). C'est là une condition *sine qua non*. Je suis bien réjoui que vous avez songé à faire passer la course (de la Société Géologique) par le Landeron, là, il y a de quoi voir, tout ce qui dans la question concerne le Jura; mais malheureusement nous n'avons les Alpes qu'à l'horizon et non pas sous nos pieds pour les comparer.

Cependant j'apporterai quelques échantillons, qui suppléront du moins, aux yeux de ceux qui n'auront pas pris d'avance le parti de ne pas vouloir *voir*. Je suis décidé à ne parler que de faits, les comprendra qui pourra. À moins qu'on ne veuille pas prendre l'engagement de ne pas discuter sur des suppositions gratuites et nier pour cela, l'existence des faits que l'on pourrait aller constater dans quelques journées. J'ai trop à me plaindre de la manière dont on a traité des observations consciencieuses pour vouloir prendre part une seconde fois à un pareil scandal (cela se rapporte aux critiques injustes et assez acerbes de von Buch et Élie de Beaumont à Neuchâtel l'année précédente).

D'ailleurs soyez persuadé, Monsieur, que je me fais une fête d'aller à Porrentruy, et que je compte m'y trouver dès le 4 (septembre) au soir. Notre ami Gressly est gravement indisposé, je crains bien qu'il ne puisse pas être des nôtres (Gressly n'a pu se rendre à la réunion).

J'espère beaucoup de notre visite au Landeron pour l'examen de la question des anciens glaciers et des grandes nappes de glace anté-alpines.

Agréez, Monsieur, l'assurance de ma considération distinguée.

Ls. Agassiz.

A preceding letter to Thurmann, dated Neuchâtel, 27 January, 1836, after Agassiz's return from England, contains the following judicious remarks: —

C'est peu de jours avant mon départ pour l'Angleterre que j'ai reçu l'intéressant envoi de fossiles que vous m'avez adressés. Maintenant je vais m'occuper de les examiner. Ces objets sont d'autant plus précieux que j'en ai vu de semblables dans les terrains jurassiques d'Angleterre, et que nous avons des termes de comparaison précis pour les gisements. J'ai regretté que mon absence, m'a privée du plaisir d'assister à la réunion de la Société géologique du Jura, société qui sera d'une grande utilité pour éclaircir les questions géologiques de notre pays. [The meeting of this society, founded by Thurmann at Neuchâtel in 1834, was at Besançon, in September, 1835, and it was during the session of Besançon that Thurmann proposed to give the name *Neocomian* to the lower part of the Cretaceous rocks.] Les questions de mode de dépositions des roches, dû rôle des polypiers, des équivalents géologiques, de la succession des fossiles, de leur apparition et de leur disparition sur la terre, des soulèvements, etc., ne se présentent nulle part d'une manière aussi engageante que chez nous. Je compte assister à votre prochaine réunion [that society never met again, after the Besançon meeting of 1835], et je me réjouis de penser que vous avez déjà donné une face nouvelle à l'étude du Jura.

Farther on he adds: —

La clef des Alpes est dans le Jura me répéte M. Voltz, et il ne paraît plus douteux à ce dernier que les assises calcaires supérieures des Alpes [then called *Alpine limestone*] sont la continuation immédiate de notre terrain crétacé, et s'il en est ainsi, on pourra paralleliser toutes les couches des Alpes avec les affleurements des différens soulèvements jurassiques.

On the day after his return from the Oberland, he again left Neuchâtel en route for Chamounix, taking with him, besides his first companions, several artists and a young doctor, making a company of ten persons. Their first halt was at Bex, the Mecca of glacialists, to visit de Charpentier; who, with his usual generous hospitality and good nature, received the whole party and showed all the glacial remains, and even the stratigraphy of the salt mines, giving most clear and important explanations. From Bex Agassiz and his party visited, on foot, the valley of the Rhone between Bex and St. Maurice, the traces of the landslide of the Dent-du-Midi, and all the places most remarkable for glacial action shown to Agassiz two years previously by Venetz and de Charpentier. Crossing from the Valais by Valorsine to the valley of Chamounix, they visited the "Glacier des Bois," Montanvert, and "la mer de glace," whence they returned by the Col de Balme to Bex, visiting on the way the "Glacier du Trient."

As soon as they had returned to Neuchâtel, after a week's absence, they started again, but this time to go to the meeting of the Geological Society of France, at Porrentruy, the 5th of September. The meeting, presided over by Thurmann, was largely attended and most important. The glacial question was debated in the most spirited way; for de Charpentier was there, and Agassiz, excited by his presence, surpassed himself in trying to convert to the new theory every one present, and gave a vivid exposition of what he had just seen in the Bernese Oberland and at Chamounix. This

time he was more successful than at the meeting of Neuchâtel, the year preceding. His celebrated address of 1837 had excited the curiosity of many geologists; and some, like Captain Leblanc of Montbéliard, had gone so far as to find undeniable proofs of the existence of ancient glaciers among the Vosges Mountains, proofs which were presented before the society as new facts to be added to those of Venetz, de Charpentier, and Agassiz, observed in the Alps and the Jura. One of the first converts to the glacial theory was the celebrated d'Omalius d'Halloy, who acted during the meeting as vice-president; and Bernard Studer, already well known as the geologist best informed in regard to the Bernese Alps, as well as the Molasse of Switzerland, and until then a most stout opponent, was compelled by Agassiz's explanations and enthusiasm to moderate gradually his opposition. As he afterwards said to me, Agassiz was almost irresistible in all his explanations, having a ready answer to all objections. Agassiz presented to the society, the 6th of September, his "Observations sur les glaciers," in which, though attacked by Studer, he was sustained by de Charpentier, Hugi, Max Braun, Leblanc, Guyot, and Renoir. The paper is one of Agassiz's best; it was published first in the "Bibliothèque Universelle de Genève," Tome XX., p. 382, December, 1839, more than a year after its delivery before the French Geological Society, and again in 1840, in the "Bulletin Soc. Géol. France," Vol. IX., p. 407. In it he quotes the observations of Max Braun and A. Guyot on surfaces polished by ancient glaciers

near the Lake of Thun and at Oberwald, in the upper part of the Valais. Guyot had added some new facts (*considérations*) to the observations of Agassiz; but he did not write a note of what he said after Agassiz had spoken. Agassiz's secretary was at the meeting; for we find in the list of persons present not belonging to the society "M. Desor, géographe à Neuchâtel."

In an excursion of the society from Soleure to Bienne, following the foot of the Weissenstein, and at la Neuveville, Agassiz showed numerous boulders and rocks polished by glaciers. De Charpentier agreed entirely with Agassiz, and the majority of the fellows of the Geological Society accepted the new view and the glacial theory as the only possible explanation of the phenomena.

Directly after the meeting of the Geological Society of France at Porrentruy, Agassiz left for Germany to attend the meeting of the Association of German Naturalists at Freiburg-im-Breisgau in the Grand Duchy of Baden. During the sessions, which lasted from the 18th to the 24th of September, 1838, Agassiz had occasion to repeat, with great force, all the arguments relating to glaciers, the glacial doctrine, and the existence of old glaciers in the Jura, the Vosges, and the Schwarzwald. On the 25th, accompanied by Prince Charles Lucien Bonaparte, and Professor and Mrs. Buckland, he left Freiburg for Neuchâtel.

At Neuchâtel, Agassiz had his hands more than full. The lithography he had established, under the direction of H. Nicolet, turned out splendid plates of fossil fishes,

by a new process of printing in various tints on different stones; what has since been termed chromolithography or lithochromy. Nicolet had engaged at Paris a French artist of great ability, Auguste Sonrel, who managed admirably with large plates, and succeeded in printing folio plates with a remarkable uniformity of colouring, as may be seen in the atlas of the "Poissons fossiles."

The studio for moulding, under the direction of Stahl, a most skilful moulder, was actively at work making casts of the inside of shells and of echinoderms, and also of topographical reliefs of the Jura Mountains, by Gressly, to show their geological structure.

We must at this time mention an addition to the staff of employés under Agassiz. There was at the meeting of the Swiss naturalists at Neuchâtel, in 1837, a very odd kind of antediluvian or primordial man, so antiquated that he seemed as if he belonged to the Jurassic period and not to our time; very awkward, timid, extremely modest, and yet so learned in practical geology that no part of the geology and palæontology of the Jura had escaped his researches. He knew every topographical feature of the Jura, every group of strata, and almost every kind of fossil remains. With great embarrassment he presented to Agassiz a letter of introduction from Jules Thurmann, the great Jurassic geologist of the Bernese Jura, by which Agassiz was informed that the name of the young geologist before him was Armand Gressly. Gressly, in the hurry of the meeting, did not dare to take from one of his large pockets the manuscript of his "Observations géologiques sur le Jura

Soleurois," but waited until after the session was over to call at Agassiz's home and present it for publication in the "Mémoires de la Société Helvétique des Sciences Naturelles." After reading the first twenty pages, Agassiz promptly saw that it was a paper of the first order, containing a quantity not only of new materials, but also of new ideas. In it Gressly proposed the theory of *facies* or "aspect des terrains," as he called it, an expression which has been constantly used the world over to explain the different association of species of fossil form, according to the deposits in which they are buried, or more exactly according to the character of the sea-bottom on which these animals had lived and associated.

Not only was the long memoir of Gressly, with a quantity of coloured sections and panoramic geological views, accepted by the committee of publication of the Swiss Society, of which Agassiz was the president, but Gressly was also closely interrogated and, as it were, interviewed by Agassiz. Although Agassiz had already met all the leaders of geology and palæontology, and a great number of practical collectors of fossils, he had never met such a curiously original observer. Gressly possessed in a rare degree precisely what Agassiz wanted, — the ability to observe the stratigraphy and to classify the different groups of rocks of a formation. Agassiz saw at once all the service he would get from such a rare practical geologist, and he offered to purchase his collection for the young Neuchâtel Museum, just organized, and proposed to

him to go into the field for fossils and bring back all he could collect, arranging the specimens by strata, cleaning them, and further to revise the practical geology of all his publications on fossils. No regular pay was to be given, for Agassiz's money was already engaged to defray more than it could reasonably provide for; but Agassiz promised to provide his lodging and board, to pay his travelling expenses, and to give him money when wanted for his personal needs, if at such times Agassiz had any. In a word, it was the same unbusiness-like arrangement which Agassiz used almost all his life, and which was a constant source of difficulty with all his assistants. With Gressly the arrangement was perfectly satisfactory, and, strange to say, he was the only one who never gave any trouble to Agassiz. But Gressly was so easily contented, so timid, and had so few wants, that he was the cheapest savant imaginable to support.

A few details will give an idea of the man and his very limited requirements. Agassiz had to pay for his lodging, which consisted of a small bedroom, poorly furnished, and which soon became a true pandemonium of the most sordid kind. He boarded when in Neuchâtel at a third-rate inn called *Le Poisson*, kept by the sister of the artist Jacques Burkhardt. When travelling — always on foot — there was even less expense; for Gressly entered the first farm on his road, and asked for food and lodging. He had already roamed all over the Swiss Jura Mountains to make the observations which had resulted in his excellent "Observations géologiques sur le Jura Soleurois," and was well known personally or by reputation by almost all the country people, who

always received him kindly, giving him a place at their table and a bed to sleep in — or more exactly on; for he slept with his clothes on, even with his shoes on. The farmers liked Gressly extremely, because he not only told good stories, but also gave good advice for finding springs, digging wells, and he indicated good places for marls and clays used in agriculture, and for stone quarries. Like a child, as he was all his life, he played with the children, making cocks and boats and dancing frogs out of pieces of old almanacs or newspapers. As an example of his cheap way of travelling, he once started with a small sum of money in his pocket, then he forgot that he had any money, and remained two or even three months without spending a penny, going from farm to farm, and returned loaded with the most splendid and rare fossils. And when asked why he had stayed so long without writing, — "Why!" said he, "you forgot to give me any money, and I was obliged to do as well as I could with my friends the *paysans*, who generously gave me board and lodging as I went along; a slow process," he added, "which took much of my time." "But, Gressly, I gave you some money before you started, and I saw you, if I remember rightly, put it in that pocket," indicating the pocket. Gressly put his hand in his pocket, and brought out the gold pieces which had been there, forgotten, ever since he started two months before.

As to clothes and linen, he was even more indifferent; with the exception of two pairs of strong shoes, a knapsack to put his specimens in, and a medium-sized geological hammer, everything was of the cheapest

kind. He carried no change of clothing, but added shirt upon shirt, whenever he received a new one; and instead of appearing the rather slender man that he was, he gradually assumed the appearance of a very large and bulky workman. Indeed, he was constantly taken for a quarryman or a mason.

It was Gressly who collected all the materials for Agassiz's Monograph of the *Mya* and *Trigonia*, and also the majority of species of fossil echinoderms used by Agassiz in his works on that family of sea-urchins, and he also collected almost all the Jurassic and Neocomian fossil fishes.

Agassiz was not a business man, but he had found in Gressly one even less able to care for money matters, so they lived in perfect harmony. But sickness came to Gressly, who, after rallying, ended his life prematurely, at the age of fifty-one, in an insane asylum at the Waldau, near Berne. Gressly's admiration and respect for Agassiz lasted as long as his mind was not obscured.

It has been said that Desor wrote a large part of the "Observations géologiques sur le Jura Soleurois," and that Gressly was a pupil of Agassiz; but this is altogether a mistake. The manuscript of Gressly was written during 1836 and 1837, in the library of Thurmann at Porrentruy. Thurmann was constantly asked for help, which was always readily given, and read over and corrected all the rather numerous Germanisms in the French of Gressly. When Gressly started from Porrentruy to go to Neuchâtel, he carried with him his manuscript, which was delivered into the hands of

Agassiz in July, 1837, three months before Desor came to Neuchâtel, and before the name of Desor had been heard by either Gressly or Agassiz. To be sure, Gressly did learn some palæontology during his stay with Agassiz, and felt his influence; but Gressly above all was a practical geologist and a practical palæontologist, who learned all he knew of those two sciences, as he himself told me, from Professor Voltz of Strasbourg, and more especially from Thurmann; and he always called himself the pupil of Thurmann.

In 1838, two events of interest to Agassiz happened in Neuchâtel: first, his unanimous election by the counsellors of the city as "Bourgeois de Neuchâtel," and the second, the foundation of the Academy. We read in the Manuals of the Council of Neuchâtel, kept at the City Hall, the following deliberation, April, 1838: "M. le maître bourgeois en chef rappelle les services considérables que M. Jean-Rodolphe-Louis Agassiz, originaire d'Orbe et de Bavois, canton de Vaud, professeur d'histoire naturelle, rend à la Bourgeoisie et au Pays en général par l'application qu'il fait de ses vastes connaissances à l'enseignement public et par le lustre que sa réputation universelle répand sur notre patrie et sur la ville de Neuchâtel en particulier, à laquelle il donne des preuves du plus sincère attachement, ayant refusé des offres avantageuses et réitérées de places dans les cantons voisins et dans les premières universités de l'Europe. Des mérites aussi distingués ont déterminé MM. les Quatre-Ministraux à proposer au Conseil de faire attribuer à ce savant, que déja le Gouvernement a naturalisé sujet de cet État, la qualité de *Bourgeois de Neu-*

châtel, et cela a titre gratuit. Sur quoi par délibération consultative, le Conseil a unanimement approuvé la proposition, et à la même unanimité il a confirmé cette délibération au scrutin pour être soumise à la ratification de la communauté." The title of "Bourgeois de Neuchâtel" was more than merely honorary, for it carried with it pecuniary benefits, and is very seldom conferred gratuitously.

The king of Prussia, Frederick William, by an order to his Secretary of State, dated Berlin, March 17, 1838, gave for ten years ten thousand louis to develop public instruction in Neuchâtel, and Agassiz was confirmed as professor of natural history; he did not receive his diploma, however, until 1840, for two years passed before the Academy was finally organized. Arnold Guyot was invited to deliver a course of lectures on geography, a year later, 1839–1840, and Dubois de Montperreux, the Caucase traveller, also delivered lectures on archæology. For a small town and small canton, as Neuchâtel was then, the creation of an academy was a great occurrence, and did honour both to the prince of Neuchâtel, king of Prussia, and to the City Council of Neuchâtel.

CHAPTER VII.

1839–1840.

Agassiz's Scientific Activity; the Help rendered by his Secretary Desor — An Interesting Business Letter to Pictet — Dispute with Edward Charlesworth about the French and German Translation of Sowerby's "Mineral Conchology" — Visit to the Monte Rosa and the Matterhorn — The Geologist Voltz of Strasbourg — Studer's Conversion to the Glacial Doctrine — Old Glaciers in the Vosges — Search on the Glacier of the Aar for Hugi's old Cabin — Karl Vogt's Arrival as Assistant to Agassiz — The Household and Laboratory of Agassiz at Neuchâtel — The "Echinodermes fossiles de la Suisse" — "Études sur les Glaciers" — The "Essai sur les Glaciers," by de Charpentier — Letter of Agassiz to de Charpentier — The "Hôtel des Neuchâtelois" on the Aar Glacier — Visit of Mrs. Agassiz and Alexander to the Glacier — Journey to England — The Glacial Theory in England — Agassiz's Discovery of Ancient Glaciers in Scotland, Ireland, and England — Letter to Humboldt.

The scientific activity of Agassiz during 1839 was something unique in the history of natural history researches. His secretary, Desor, had made such progress under the direction and teaching of Agassiz, that he began to be useful in original scientific observations. With a remarkable capacity and a marvellous elasticity of mind, Desor, in less than two years, had learned enough of all the branches of natural history cultivated by Agassiz to be already helpful, not only

in writing under the dictation of Agassiz, but also in using his own gifts in description of species and notes on the glacial question. As Vogt says: "Desor jusqu'à son arrivée chez Agassiz, ignorait et était presque complétement étranger à toutes les branches d'histoire naturelle. Infatigable au travail, Desor était en même temps un compagnon aimable et dévoué, ayant toujours le mot pour rire et maniant avec bonhommie la plaisanterie et même l'ironie gracieuse." [1]

The notes to be used in preparing the "Études sur les glaciers" were put in order by Desor; in addition, he corrected all the proofs of the "Poissons fossiles," the "Echinodermes de la Suisse," the "Mémoire sur les Trigonies," and the "Observations géologiques sur le Jura Soleurois," and began work on the "Catalogue of all Books, Tracts, and Memoirs on Zoölogy and Geology," the "Catalogus systematicus ectyporum Echinodermatum fossilium Musei neocomensis," and finally at the "Nomenclator Zoologicus."

Agassiz gave all his assistants so much to do that it was impossible to keep pace with his eager desire and ardour for scientific publication. When we remember that it was in a small town of six thousand inhabitants that such publications were all started simultaneously by the invincible will of one man, and that all these great undertakings required not only steady and hard work but also time and money, — for Agassiz from that day published everything, with very few exceptions, "aux frais de l'auteur," — it is almost incredible. We have no exam-

[1] "Discours à l'Institut National Genevois," le 23 Mai, 1882.

ple of such impulse given to natural history anywhere, even in such great scientific centres as Paris or London. His generous spirit can be understood by reading the following extract from a letter to his friend, Jules Pictet de la Rive, dated Neuchâtel, March 10, 1839:—

Je suis également bien réjoui de pouvoir vous montrer que quoiqu'éditeur *forcé* de mes publications, c'est uniquement le désir d'être utile qui me guide vis-à-vis de mes collègues qui désirent acquérir mes ouvrages. Pour les Poissons fossiles, je vous les céderai volontiers au tiers au-dessous du prix que les libraires y mettent, c'est-à-dire à 24 francs la livraison, au lieu de 36, ce qui est à peu près le prix auquel elle me revient. Veuillez dès lors me faire savoir si je dois vous en adresser un exemplaire. Dès que j'aurai calculé exactement le coût des "Poissons d'eau douce," je vous ferai savoir aussi qu'elle remise je pourrai vous faire sur cet ouvrage. Il va sans dire que ce n'est qu'aux savants, qui me demandent mes livres pour eux-mêmes que je peux et que je veux faire le sacrifice de toutes les peines que reclament des publications de ce genre.

Generosity in this case was certainly not well placed; for Pictet was a well-to-do man in a pecuniary position far superior to Agassiz's, and might easily have afforded to subscribe at the full price. But Agassiz did not know how to discriminate between those who deserved to be helped and those whose means were such that a subscription to a costly work was not a "sacrifice," but simply a scientific duty.

About this time occurred, for the first time, a disagreeable difficulty which confronted Agassiz more than once during his life. Without asking permission, or even making his intention known, he had begun a French and a German translation of the "Mineral Conchology of

Great Britain." The Sowerby brothers, who were the authors and publishers of this costly work, thought the proceeding a little too high-handed; and the editor of "The Magazine of Natural History," Edward Charlesworth, published a rather sharp article in the May number (Vol. III., p. 254, London, 1839), in which he calls it a "piracy upon the literary production of English naturalists," and adds, "Agassiz has met with the most cordial support on all sides, and in various ways, from the cultivators of science in this country; and, although it may appear harsh thus to express ourselves, we do not hesitate openly to declare our conviction that in editing a transcript in the French language of the 'Mineral Conchology of Great Britain,' its author cannot be said to have really promoted the objects of science, still less to have added to his own reputation."

Agassiz promptly answered, in an autograph letter addressed to all his correspondents and subscribers, and reproduced in French and also in English in No. 31 of the "Magazine of Natural History" (Vol. III., p. 356), entitled, "Lettre écrite par M. Ls. Agassiz à M. Ed. Charlesworth, en réponse à une article inséré dans le No. 29 du 'Magazine of Natural History.'" In this Agassiz says, "The assertions and insinuations of the article are altogether malicious and without foundation. . . . The knowledge which I possess of the most important European scientific publications has assured me that a French or German edition of the work, published at lower price (one-fourth the cost of the original work), would be rendering a real service to science, without in any way proving injurious to the original edition, for

which the principal demand is in England. Would it then not be unfair to represent such a publication as a systematic piracy; as though translations of scientific works were not being made every day with the consent of the authors?" Yes; but unfortunately Agassiz had failed to get that consent from Sowerby's sons, the collaborators and finishers of the "Mineral Conchology." There lay the mistake. Agassiz adds: "I affirm that the insinuation of my having entered upon this undertaking with a view to pecuniary emolument, to be altogether unfounded. On the contrary, only three hundred copies have been struck off, and I agreed with the editor, as the price of my participation in it, that the work should not be sold at a sum above that necessary to cover the expense of its publication." In regard to his own "Poissons fossiles," he says, "I shall esteem myself fortunate to see the work translated in whatever shape it may appear." Charlesworth rejoined, reiterating all his previous criticisms, and adding others; and finally, James De Carle Sowerby wrote a letter, the 27th July, 1839, also inserted in the "Magazine of Natural History," Vol. III., p. 418, in which he approved the strictness of Charlesworth, and suggested that some protection be afforded, at least by their *brother authors*, to those who make original and costly publications. It seems from his letter that the "sale of the 'Mineral Conchology' has only been about four hundred copies, above one-fourth of which number have been sent abroad. The encouragement, therefore, for carrying on the work has hitherto been not very great."

Agassiz, from the start of his lithographic establishment, under the direction of H. Nicolet, was very anxious to procure works sufficient to keep it running all the time, without too great pecuniary loss. His intention was good, and he began the two translations in French and German with the hope of helping that numerous class of observers of limited means on the continent of Europe, to whom Sowerby's original English edition was inaccessible on account of its great cost. I myself saw a few years after, when Agassiz's translations were hardly finished, how useful they were to French and German geologists, and they really helped the progress of science in Central Europe. The only error, and it was inexcusable, was his undertaking the work without having previously obtained permission from the two sons of Sowerby, who wrote the principal part of the text, and finally engraved also the plates, after the death of their father in 1822. Pecuniarily the enterprise was a great loss to Agassiz, for after a few years, Nicolet failed, and Agassiz had to take the whole business into his own hands. Neither of the translations sold well, and other more important works on the palæontology of France and Germany soon appeared and blocked the way. Among these were the "Paléontologie française," by Alcide d'Orbigny, and the "Petrefactenkunde von Deutsland," by Quenstedt, which not only attracted attention, but from the start were paying works, — a mark of success which was never to be granted to Agassiz during his stay in Europe. Afterwards Agassiz very seldom referred to these two translations; it was a painful subject, and he confessed that

it was an error which cost him time, money, and, what is of more value, reputation among some of the English naturalists. However, he retained the friendship of all the leaders in England, and it is refreshing to read such remarks as the following: "His [Agassiz's] knowledge of natural history surprises me the more I know of him, and he has that love of imparting it, and that power of doing it with clearness, which makes one feel one is getting on, and that one has caught his enthusiasm" (Life of Charles Lyell, Vol. I., p. 457). "We are great friends," Edward Forbes wrote, after the conclusion of the meeting of the British Association at Glasgow, "and were together all the Association week. I expect him here on the 21st October; he is to work over my species with me, so as to avoid useless synonyms. . . . We worked over the synonyms, freely telling all he [Agassiz] knew, and confessing all he did not know. . . . He also gave in to my classification of the Echinodermata, admitting the Ophiuridæ as a group equivalent to the starfishes, and granting that the Sipunculidæ are Radiata" (Memoir of Edward Forbes, pp. 263, 264).

At the beginning of August, 1839, Agassiz went to the annual meeting of the Helvetic Society of Natural Sciences at Berne, where discussion on the glacial question continued to attract attention. Studer, who presided over the society that year, proposed to Agassiz to go with him to see the glaciers of Monte Rosa and the Matterhorn in Valais. The party, composed of seven persons, six naturalists and an artist, Bettannier, started from Berne the 9th of August, 1839, passing by Kandersteg to see its beautiful old moraine, already celebrated,

through the agency of Professor G. Bischoff of Bonn, who had announced its peculiarity, and by the Gemmi Pass to the bath of Louèche. Here they met the great geologist, Professor Voltz of Strasbourg, and a most delightful evening was passed in his company. With such savants as Agassiz, Studer, Lardy of Lausanne, Nicolet of La Chaux-de-Fonds, and Voltz, it is easy to imagine the interest of the geological subjects which they debated until almost daybreak. Studer and Lardy had been at work for several years on the geology of the Grand St. Bernard, and other Valaisan localities of the vicinity, and Voltz, who was second only to Alexandre Brongniart, the founder of correlation of strata, by means of the fossils, had worked hard at the age of several groups of rather puzzling Alpine strata, more especially the enigmatic "Poudingue de Valorsine," and his works on the Vosges, the Alsace, and the Jura Mountains laid the basis of all that has been done there since. He was the teacher of such great geologists as Thirria, Thurmann, and Gressly, and the creator of the Palæontological Museum at Strasbourg — at that time one of the richest in Central Europe. He was, beside, a most interesting talker, full of all the socialistic theories of the time, Saint Simonian and Phalansterian, as well as an ardent republican and a friend of all political refugees, from whatever nation they came. Alas! it was for Voltz one of his last opportunities to meet the geological friends who were so congenial to him, for he died a few months after,[1] regretted by all who had the

[1] Philippe Louis Voltz, born in Strasbourg the 14th August, 1784; died in Paris the 15th January, 1840.

good fortune to know him, and by none more than by Agassiz.

From Louèche to Zermatt, "roches moutonnées" and polished boulders and moraines were met in abundance, more especially near Zermatt. At that time there was no hotel of any kind at Zermatt, and the party found lodging and board at the house of the physician of the St. Nicolas valley. Tourists had not yet discovered Zermatt, and with the exception of a few botanists and zoölogists, no one ever came to these remote parts of the Valaisan Alps. When on the Riffel, Studer, who until then had opposed the glacial theory and had explained every erratic phenomenon by mud currents, was at last convinced; his only remaining objection, after admitting ancient glaciers, being that he feared the consequences. Seeing a vertical wall of serpentine finely polished, he asked the guide to what that phenomenon was due. The guide, who had not the smallest interest in the glacial question, answered with great *naïveté*, that in the country (le pays) everybody thought that it was made by the glacier, adding: "It is true that no inhabitant of the village remembers to have seen the glacier in this place, but it was there formerly, for it is always in this way that the glaciers wear away the rocks." With great honesty Bernard Studer, who had been one of the stoutest opponents of the views of Venetz, de Charpentier, and Agassiz, confessed his errors in a "Notice sur quelques phénomènes de l'époque diluvienne" ("Bull. Soc. Géol. France," Vol. XI., p. 49. Meeting of the 2d December, 1839, Paris).

This conversion of such a prominent alpine geologist induced many other Swiss geologists, who, until then, had hesitated to adopt the glacial theory as proposed by Venetz and de Charpentier, — a theory which was extended by Agassiz to embrace almost the whole of the Northern Hemisphere. It was a great gain, due mainly to Agassiz ; and from that day no more serious objections were made in Switzerland.

Curiously enough, directly after the reading of Studer's paper, Renoir of Belfort published a most important paper on the glaciers of the southern part of the Vosges. In it he declared that when Captain Le Blanc of the French Engineer Corps, at the meeting of the society at Porrentruy in 1838, announced the existence of old moraines in the Vosges, he disbelieved him ; but started at once for the valley of St. Amarin as soon as the meeting was over, and to his astonishment found there proofs of all the glacial phenomena as established by Venetz, de Charpentier, and Agassiz.[1]

The proofs given by Professor Renoir, as well as the argument advanced by Captain Le Blanc, left no further doubt as to the existence of glaciers during the Quaternary period in the Vosges, and Professor Fargeaud of Strasbourg had extended his observations on ancient glaciers even to the Black Forest of Baden, and to the Pyrenees. So promptly did Agassiz's prophecy in the address at Neuchâtel in 1837 receive confirma-

[1] Note sur les glaciers qui ont recouvert anciennement la partie méridionale de la chaine des Vosges (" Bull. Soc. Géol. France," Vol. XI., p. 53, Paris).

tion beyond the Alps. After leaving Zermatt, and on an excursion to Mont Cervin, Agassiz and his party visited the glacier of Aletsch, the greatest of all the Alps, with its Merjelen (Méril) lake, unique in Switzerland; then the glacier of the Rhone, and afterward the Grimsel again. Agassiz, desirous to see the place where the monk Hugi of Soleure, some years previously, had established a cabin on the glacier of the Aar, took a guide at the Grimsel and ascended the valley of the Ober-Aar. After a rather exhausting walk over the glacier for three hours, the guide showed a well-preserved cabin on the median moraine close by an enormous granite boulder. In this they found a bottle containing several papers, one of which informed them that, in 1827, Hugi constructed a dry-walled cabin with a floor of hay, and from a second paper, also written by Hugi, they learned that he had visited his cabin again the 22d of August, 1836, and found that it had descended the glacier 2028 feet since it was built in 1827. Agassiz was much impressed by this discovery of Hugi's cabin and its motion, and he then resolved to return the next year and imitate Hugi in order to continue his researches on glaciers.

During the excursion Joseph Bettannier, who was a good landscape artist, made several very exact drawings of the glaciers round Zermatt, Monte Rosa, Viesch, Finelen, Aletsch with its lake, St. Théodule, and Aar with Hugi's cabin, to be used for an atlas to accompany the "Études sur les glaciers."

Agassiz returned to Neuchâtel at the end of August. Soon after, an important change was made in the house-

hold involving an important addition to it. Young Karl Vogt, just graduated doctor from a German university, arrived on the last day of August, as had been agreed two years previously in October, 1837, when Agassiz was visiting his father at Berne. Karl was to help Agassiz in his publication and researches touching fossil and living fishes, and new arrangements became necessary to meet the increase of expenses. Never practical, and becoming more and more accustomed to gather round him as many assistants and social companions as he could, Agassiz could find no better way to diminish his expenses than to give Desor and Vogt their board at his own table; Desor already had a room in the house, and another near by was taken for Vogt. In this way Vogt and Desor became members of his family, their board and lodging being entirely at Agassiz's expense. As to salary, nothing was stipulated; but when they wanted money they had to ask for it, and if Agassiz had any, which was more and more rare, he gave them some. At first the new arrangement worked very well. Agassiz had company at his meals, which was always a great pleasure to him, for he was delighted to be surrounded by brilliant and intelligent, especially scientific people. Agassiz's mother, who was visiting him at this time while his wife was in Carlsruhe, was a capital housekeeper, with much dignity of manner, and accustomed to keep every one in his place without allowing the slightest encroachment or too much familiarity.

Karl Vogt in his twenties was a character seldom

met with. Tall and very corpulent for his age, his movements were rather heavy and somewhat awkward. He was inclined to see the comical side of everything, and his remarks were all tinged with ridicule. As soon as he entered Neuchâtel, he was saluted by the nickname "Le Moutz" (*Mutz* in the dialect of Berne), a popular character well known all over Switzerland, and personifying the Bernese bear; and the name clung to him during his five years' stay at Neuchâtel.

Vogt's "bon mots" soon became proverbial, and his laughter was very infectious; so much so that he would have started a Quaker meeting into uproarious merriment, and obliged a community of Trappists to break their vows of eternal seriousness and self-control.

The reverse of the medal will appear by and by. For the present Vogt made himself as amiable and acceptable as possible. Desor, who was always imitating some one or something, adopted the same attitude, and pushed his desire to please so far, that he even accompanied Agassiz's mother to the place of worship, — quite an event for a proclaimed atheist. The German language was used exclusively at table and in the laboratory; and to a visitor Agassiz's establishment at this time of his life seemed a German settlement transferred into French Switzerland.

Vogt describes his first meeting with Gressly in the following manner: "During the fall (1839) Gressly came. Great was my astonishment when I heard

Desor apostrophize the little vagabond[1] as soon as he entered into the laboratory: 'But, Gressly, go out directly and get washed; after that I will make you acquainted with Vogt.'" Gressly with his sympathetic nature, his good temper, his many eccentricities, was the constant target and object of fun for both Desor and Vogt. What he suffered, during the six winters he passed with them, is difficult to imagine. He accepted always with a smile the most cruel practical joke, working quietly at his manuscripts, and cleaning his fossils with his tongue. As soon as the spring was begun, Gressly escaped his martyrdom in the laboratory by going into the field for eight or nine months. There the poor tramp was at least free from the sarcasms of his two persecutors. It must in justice be said that years after, when both Desor and Vogt had attained reputation and social position, they were kind to Gressly. Vogt took him as a companion during a journey to Iceland; and Desor gave him a room in his house at Neuchâtel and at his country house at Combe-Varin, until he was too ill to be taken care of outside of an asylum.

But Gressly was too much absorbed in geology to be made use of as a clerk. Desor soon found out that if Gressly was ready to be treated as a funny man, he had too much independence and was too learned to be a "saute-ruisseau," as small clerks in French notary

[1] The word is most unjust and inexact, showing that Vogt is not and never was a practical geologist. Gressly was a very steady and persistent observer, and all his explorations were always systematically carried on.

offices or bureaus are called; so he hired the young son of a peasant, named Girard, of Concise, the former parish of Agassiz's father, to be his Jack at all trades. Intelligent and desirous to become a naturalist, Charles Girard submitted to the continual and rather severe exactions of Desor; for he not only had to write under Desor's dictation, but he was constantly running between the laboratory, Agassiz's lodging, the lecture-room, the lithographic establishment, and the printing-press; besides, he was the bootblack for the whole establishment. Desor kept him very close, and punished him remorselessly by sharp reprimands, which were always accepted without a word of retort, for Desor was the head man, and not an easy one to please.

As Vogt says, during the last six years of Agassiz's life at Neuchâtel, it was a kind of scientific factory, producing more than was wanted, and glutting the market with publications, without profit to anybody. Indeed, several of the works issued might have been dispensed with, both as regards cleverness and timeliness, to say nothing of the pecuniary expense, which was always rather great, notwithstanding the cheapness of living in Neuchâtel.

However open to just criticism several of Agassiz's undertakings may be, they furnished an example of marvellous initiative and of extraordinary impulse. Every one under Agassiz's direction worked hard and well; there was a sort of rivalry as to who would do best and most. The first part of the "Description des Echino-

dermes fossiles de la Suisse," containing spatangoids and clypeastroids, appeared during the autumn of 1839, in the "Nouveaux Mémoires de la Société Helvétique." Until then no publication on echinoderms of such importance in regard to classification, correctness of localities, and stratigraphical position, had appeared. Gressly had had a great share in it, having found the majority of the specimens used, and having helped Agassiz in his descriptions and other details of each species. A special artist, Dickmann, was trained by Agassiz to draw Echinidæ, and the accompanying plates are excellent. The memoir was made use of at once, with great advantage, by all geologists studying the Jurassic and Neocomian series; and seldom has such an important and timely contribution to palæontology been made. The second part, "Cidarides," soon followed, in June, 1840; and the whole work is one of Agassiz's best, being remarkably clear, with excellent classification, good genera and species; all of which have been accepted and used since, in all the works on fossil echinoderms.

At the beginning of the winter Agassiz wrote a very interesting letter on the glaciers to Élie de Beaumont, asking him to communicate it to the Academy of Science. But de Beaumont was a rather unfair opponent in everything relating to the glacial question, and he did not read the letter to the Academy, as he was requested to do. As it is important, and allows every one to see the opposition at that time constantly made against the doctrine of the action of glaciers in the Alps, I give it almost in full, suppressing only local details relating to

the glaciers around Zermatt and Mont Cervin. Besides, this letter had the advantage of giving, before the publication of "Études sur les glaciers," advertised to appear the following year, explanations of some of the plates prepared for the folio atlas to accompany that work.

NEUCHÂTEL, 16 décembre, 1839.

LOUIS AGASSIZ
à Élie de Beaumont.

Je venais d'emballer les premières épreuves de mes planches de glaciers pour vous les envoyer lorsque je reçus votre lettre à laquelle je m'empresse de répondre. J'espère pouvoir vous adresser d'ici au printemps le cahier complet des planches que je fais faire sur les phénomènes que présentent les glaciers; celles que je vous adresse aujourd'hui ne sont relatives qu'à la formation et à la marche des moraines et à l'action des glaciers sur le fond sur lequel ils reposent. Tout ce qui concerne la structure intime des glaciers et la plus grande extension qu'ils avaient autrefois ainsi que les moraines anciennes sera figuré plus tard. J'ai voulu rester d'abord dans des limites où je suis sûre de ne rencontrer aucune opposition. Ce sera je l'espère le meilleur moyen de préparer un acceuil favorable aux phénomènes trop contestés dont j'ai déjà parlé ailleurs. Je crois que je parviendrai à les faire adopter lorsque je serai parvenu à démontrer avec le même respect qui vous anime pour les lois générales concernant notre globe, que des oscillations de température un peu plus grandes ou un peu plus faibles ne sortent pas plus du cadre des lois invariables de la physique que des phénomènes de soulèvement poussant un îlot à fleur d'eau, ou soulevant la chaine des Alpes. D'ailleurs l'étude comparative que j'ai faite d'une part de l'effet de l'eau courante, ou de grandes masses d'eau mues par les vents, d'autre part des effets produits par le mouvement des glaciers, me permet maintenant de les distinguer à quelque distance de leur source première que je les rencontre.

Mais revenons aux glaciers tels qu'ils se présentent dans leur

limites actuelles. Les Planches 1 et 2 (de l'Atlas de 32 planches des *Études sur les Glaciers*, qui a paru en 1840), que l'on peut joindre, offrent un panorama des principales sommités du Mont-Rose vues depuis le Riffelhorn. . . . Je ferai d'abord remarquer que sur la droite de la Planche No. 1, on voit distinctement une grande moraine formée autour du rocher saillant qui borde le glacier du Mont-Rose, et qui est refoulée sur le glacier principal par les glaces descendant du Lyskamm, c'est la moraine que j'appelle la grande moraine du Mont-Rose pour la distinguer d'une autre moraine moins considérable qui se forme par les éboulements, de quelques arêtes nues du Mont-Rose et qui descend à peu près sur le milieu du grand massif de glace qui sépare le Mont-Rose du Gornerhorn et qui après s'être repliée sur le milieu du grand glacier marche parallèlement avec la première. De l'angle inférieure du Gornerhorn, on voit surgir une troisième moraine séparée de la petite moraine du Mont-Rose par une série d'entonnoirs d'abord peu distincts, mais qui grandissent en face du Lyskamm et du Breithorn, pour disparaître entièrement plus bas. Je lui ai donné le nom de moraine du Gornerhorn. Enfin sur le devant de la planche on remarque une quatrième moraine qui descend du milieu de la Porte-Blanche et qui tend à se confondre avec la moraine du Gornerhorn (La Porte-Blanche est l'arrête qui domine la vallée de Macugnaga au nord du Gornerhorn). Lorsqu'on descend au pied du Riffel on remarque une cinquième grande moraine au bord du glacier, mais elle reste inaperçue sur cette planche à cause de la saillie que forment les rochers d'où le panorama est dessiné. . . .

La planche 3 représente le glacier de Zermatt au point où après avoir reçu les affluents de tous les pics il commence à descendre dans la vallée en s'engageant entre le Riffelhorn et les rochers appelés Auf-Platten. . . . La planche 4 est la continuation de la planche 3; le glacier est déjà considérablement descendu entre le Riffelhorn et Auf-Platten. Cette vue est prise vis-à-vis du Riffelhorn au bord d'une cascade qui descend du glacier de Furke en montant à Auf-Platten, tandisque les trois autres planches sont dessinées depuis le Riffelhorn. . . . En général à l'extrémité du

glacier les moraines se dispersent tellement qu'il est fort difficile de les distinguer les unes des autres. On ne les reconnoit guère qu'à la nature de leurs roches. La marche de toutes ces moraines complètement distinctes dans la partie supérieure du glacier, plus ou moins confondues dans sa partie inférieure prouve que les affluents de glace qui descendent des pics supérieures comme autant de massif distincts se réunissent plus bas en un massif homogène semblable à un grand fleuve qui vers son embouchure roule d'une manière uniforme des flots longtemps distincts, mais enfin confondus dans leur marche. . . .

Les planches 6 et 7 doivent donner une idée de l'action qu'exercent les glaciers sur le fond sur lequel ils se meuvent. . . . En pénétrant sous le glacier, entre ses crevasses, à plusieurs mêtres de profondeur j'ai pu me convaincre que le poli des roches et les stries (burinées dessus les serpentines) existent uniformément sous le glacier comme sur ses flancs, et la direction des stries que j'ai observée le long du glacier depuis le pied de la Porte-Blanche jusqu'à la source de la Viège qui sort de la voute inférieure du glacier, la direction de ces stries, dis-je, qui suivent toutes les inflections du glacier, qui sont rectilignes partout où le glacier se meut en droite ligne, qui se courbent et prennent même une direction ascendantes là où le glacier passe pardessus des arêtes saillantes de rochers: cette direction ne laisse aucun doute sur la liaison qui existe entre ces stries et le glacier lui-même. On ne saurait douter non plus quand on a poursuivi ce phénomène sur une aussi grande étendue, que les grains de quartz provenant des granites triturés dans les moraines marginales ne soient l'émeri au moyen duquel le glacier en se mouvant polit et raie le fond sur lequel il marche; il me paraît impossible de supposer que ces surfaces polies et ces stries aient existé antérieurement à la formation des glaciers, et que les glaciers aient pu se mouvoir à leur surface sans les effacer. Ces surfaces polies et ces stries sont si constantes autour des glaciers, si fraîches dessous leurs masses, si bien conservées partout où les glaciers existent encore que les habitants de la contrée les ont remarquées et les attribuent au mouvement des glaces même là où le glacier a

disparu. Leur direction presqu'horizontale tout le long du bassin du glacier de Zermatt, sur les flancs et parois du Riffel et d'Auf-Platten s'oppose à toute idée d'avalanche, comme cause de ces stries, car à raison de la configuration des lieux, toutes les avalanches qui pourraient se former, couperaient nécessairement à angle droit la direction des stries telle qu'on l'observe ; en un mot les faits sont de telle nature dans toute l'étendue du cours des glaciers que je viens de décrire, qu'il est impossible de ne pas reconnaître que c'est le glacier qui a poli ses bords au-dessus du niveau qu'il occupe maintenant et qu'il continue à polir les rochers sur les quels il repose encore. Les faits sont si parlants que M. Studer qui a fait une fois la course du Riffel avec moi s'est rendu à l'évidence quoiqu'il eût nié jusqu'alors la liaison des surfaces polies et des stries avec les glaciers. Une autre circonstance qui parle hautement en faveur de cette liaison c'est que les surfaces polies et les stries sont d'autant moins distinctes qu'on les observe sur des surfaces abandonnées depuis plus longtemps des glaciers et où ils ont cependant existé de mémoire d'homme, comme c'est par exemple le cas au-dessous de l'extrémité actuelle du glacier de Viesch, que les régistres de la paroisse d'Aunen constatent s'être étendu jusque près du village de Viesch, c'est-à-dire une lieue plus bas que maintenant.

La vallée de Viesch est une des plus intéressantes que je connaisse pour l'étude comparative de l'action des eaux et des glaces sur le fond de leur lit ; et quelque soit la cause à laquelle on attribue les surfaces polies et les stries, toujours est-il que dans chaque vallée où on les observe, elles suivent en somme la direction de la vallée, c'est-à-dire, que pour prendre des exemples precis, les stries de la vallée de Viesch s'inclinent du Nord au Sud vers le Rhône, tandisque celles qui accompagnent le glacier du Rhône sont dirigées de l'Est à l'Ouest et celles qui accompagnent le glacier de l'Aar de l'Ouest à l'Est jusqu'à l'hospice du Grimsel, puis du Sud au Nord du Grimsel à la Handeck où il est certain que ces stries existent sur les flancs du glacier de l'Aar jusqu'au niveau du col qui sépare l'Oberland bernois du Valais. Pour pouvoir attribuer ces stries à des courants il faudrait donc (abstraction faite de tous les faits que j'ai déjà cités et qui prouvent une liaison intime entre les stries et les glaciers) imaginer des courants remplissant jusqu'à les combler ces

hautes vallées et dirigés l'un du Finsteraarhorn à l'Est jusqu'au Grimsel en sens inverse d'un autre courant parallèle dirigé des sommités des glaciers du Rhône vers la Mayenwand, c'est-à-dire, de l'Est à l'Ouest et se precipitant dans la vallée du Rhône pour y rencontrer un troisième courant, tout aussi puissant dirigé directement du Nord au Sud de la vallée de Viesch ; et tous ces courants devraient naître sur la crête si étroite qui sépare ces trois vallées ; car comme vous l'avez très bien observé, les surfaces polies nous prouvent que le relief du centre de l'Europe n'a subi aucun changement notable depuis qu'il est sous l'influence des causes actuelles. Or revenons à la vallée de Viesch dont la partie supérieure est occupée par un glacier et dans le fond de laquelle coule un torrent rapide dont le cours n'est pas beaucoup plus court que ne serait le grand courant auquel on voudrait attribuer les surfaces polies et les stries de cette vallée, si jamais pareil courant avait pû naître sur les crêtes du Viescherhorn, et voyons bien qu'elle influence le glacier actuel et le torrent actuel exercent sur le fond de leur lit.

Les roches au bord du glacier et sous le glacier sont polies et striées dans toute l'étendue que recouvre maintenant le glacier. Partout où l'on peut pénétrer sous la glace ou déblayer la grande moraine qui l'entoure, les stries et les surfaces polies sont fraiches et la direction des stries ne laisse aucun doute sur la cause qui les a produites, ici encore elles sont dues aux glaciers Il est vrai que le torrent qui corrode le fond de cette vallée y creuse des sillons sinueux et polit les cotés de son lit, mais ces polis effectués par l'eau ont un aspect tout différent, ils sont mats, creux, souvent même incrustés ; ce sont des coups de gouge plus ou moins allongés, limités par des arêtes saillantes ; jamais ils ne sont striés ; jamais ils ne présentent de surfaces un peu étendues, tandisque les surfaces polies par le glacier sont bosselées en relief, les parties saillantes sont surtout striées et les parties dans la roche ne font jamais saillie. Les surfaces polies qui sont encore maintenant sous le glacier dans cette vallée sont la continuation directe de celles sur lesquelles le glacier ne repose plus, mais sur lesquelles on sait qu'il a reposé jadis. Ces surfaces polies dénudées que l'on voit sur les côtés du cours du torrent sont striées dans le même sens que celles que l'on voit encore sous le glacier ; elles différent complètement des surfaces corrodées

par l'eau du torrent, mais elles sont identiques avec les parois de la vallée qui ont conservé leur poli. Mais comme on ne voit aucune trace analogue à celle du torrent dans la partie supérieure de la vallée, tandisque ses parois sont striées et polies à de grandes hauteurs absolument comme sous le glacier, il me parait d'une bonne logique de conclure que la cause qui a agi plus puissament autrefois que maintenant, était un glacier plus étendu et non pas un grand torrent. Je n'entrerai pas ici dans le détail des différences très notables que présentent les roches de différente nature sous l'influence des glaciers et sous celle des courants, vous l'avez sans doute déjà remarqué. Je me bornerai à dire que les serpentines de la vallée de Zermatt et du Riffelhorn présentent le plus beau poli que je connoisse; que les granites des parois du glacier de l'Aar ne le cède en rien aux serpentines là où ils n'ont pas été encore exposés à l'action de l'air, mais que l'atmosphère les rend facilement rudes au toucher; que les gneiss ne conservent guère de traces de stries et de polis, que lorsque les glaciers ont agi sur les tranches de leurs couches; que les calcaires, tout en prenant facilement un très beau poli ne le conservent pas facilement lorsqu'ils ne restent pas recouverts par le limon des moraines après avoir été polis. Cela est si vrai, que dans les Alpes ce n'est guère que sous les glaciers mêmes que les calcaires alpins conservent les traces de leurs stries; ces faits sont une nouvelle preuve bien puissante de mon assertion, que les surfaces polies et les stries sont réellement dues aux glaciers et ne peuvent point avoir été simplement conservés sous les glaciers.

Dans l'exposé de ces faits je me suis restreint aux phénomènes tels qu'ils se présentent dans les Alpes, afin de ne point réveiller les objections qui n'atteignent que leur extension dans des régions où les glaciers n'existent plus; plus tard je reviendrai sur les glaciers du Jura, lorsque l'ensemble de mes observations sera aussi concluant pour ces contrées qu'elles le sont pour les Alpes. Je dirai seulement que mes courses de cet automne m'ont fourni de nouvelles preuves de la liaison qui existe entre les blocs erratiques du Jura et les glaciers. J'y ai acquis en même temps la conviction qu'il a existé dans l'intérieur du Jura des glaciers indépendants de ceux des Alpes. Les physiciens s'arrangeront de ces faits comme ils le pourront, mais je ne crois pas qu'il y ait quelque chose de plus contraire aux lois de la

physique dans les phénomènes qui nous démontrent l'existence d'une création (de faune et de flore) tropicale en Suisse, que dans ceux qui lui assignent à une autre époque un climat boréal.

En vous adressant prochainement les autres planches de mon livre je les accompagnerai de quelques observations sur la marche des glaciers, sur leur formation et sur leur structure intime. Une troisième notice sera relative aux phénomènes éloignés des Alpes qui je crois se rattachent à ceux dont je viens de vous entretenir. Avant de les publier je désirerais vous les soumettre dans leur ensemble.

Vous m'obligeriez infiniment en m'exposant d'une manière précise les objections que vous avez à faire à ces considérations. Quoique j'aie déjà fait de nombreuses observations thermométriques sur les eaux courantes et sur les petits lacs et les mares des glaciers et sur les glaces mêmes, je fais de nouveaux préparatifs pour aller étudier l'été prochain les profondeurs des glaciers en faisant des sondages pour traverser tout le massif des glaciers et pénétrer jusque dans le sol sous-jacent. Si vous aviez quelques observations à me proposer, je les ferais avec le plus grand plaisir, je serais également fort redevable à M. Arago s'il voulait bien me faire part de ses *desiderata* relativement aux glaciers. Je compte passer l'été prochain plusieurs semaines dans le cœur des Alpes.

J'ai visité cet été tous les abords de la grande mer de glace qui s'étend entre le Valais et l'Oberland afin de m'orienter préalablement, et mon intention est de la traverser dans tous les sens si le temps m'est favorable J'ai déjà pénétré par le glacier de l'Aar jusqu'au pied du Finsteraarhorn, et par le glacier d'Aletsch jusqu'au pied des Viescherhorner, derrière la Jungfrau, et passé de là au glacier de Viesch. Mon projet serait de traverser de Grindelwald au Grimsel par l'arête d'Ashchwung.

Si vous pensez que ces observations puissent intéresser l'Académie des sciences (de l'Institut de France), vous m'obligeriez en lui en communiquant succinctement le contenu. Ne jugez pas trop sévèrement mes dessins, mais pensez à la difficulté qu'il y avait à encadrer dans des dimensions données, des vues privées de toute végétation, ne représentant que des rochers nus, des glaces, et des neiges, où l'on rencontre à peine des êtres vivants, par ci par là seulement quelques Pyrrhocorax, quelques Gélinottes, rarement des marmottes, plus

rarement encore des chamois et d'où les habitations des hommes se voient dans le lointain, au fond des vallées, comme dans l'abyme.

Je vais faire copier mes croquis du Jura pour vous les envoyer immédiatement. Je ne tarderai pas non plus à vous envoyer ma notice sur vos Echinodermes.

The winter of 1839–1840 was employed in writing, besides the continuation of the "Fossils Fishes," a volume on the glaciers, and two monographs on the echinoderms, and on the *Trigonia;* and Vogt translated the manuscript of the "Études sur les glaciers" into German, in order to have the French and German edition issued at the same time. The book appeared in September, 1840, with a splendid folio atlas of eighteen beautifully executed plates. In it Agassiz very frankly gives an account of his five months' companionship in 1836 with de Charpentier, who taught him the glacial doctrine, and of his returning with several of his friends: among them, Karl Schimper, Francillon of Lausanne, who became his brother-in-law, Max Braun, Dinkel, and his secretary, to visit again the classical localities first shown to him by de Charpentier. The historical part on the glaciers is very full and just to every observer who had entered the field before him. The work is dedicated to "M. Venetz, Ingénieur des Ponts et Chaussées au Canton de Vaud, et à M. J. de Charpentier, Directeur des Mines de Bex." Notwithstanding all these precautions, the work displeased Venetz, de Charpentier, and Hugi, his three predecessors in the study of the alpine glaciers of Switzerland. De Charpentier was at work on his volume "Essai sur les glaciers," which was then passing through the press,

and he thought that his pupil Agassiz might have waited until he himself had given to the world his researches, before printing what he had learned from him. It was a question of politeness, which de Charpentier emphasized perhaps too strongly, for Agassiz did not intend to wound him; on the contrary, he proclaimed the priority of Venetz's and de Charpentier's discoveries. But the method used by Agassiz shows a want of courtesy in his eagerness to propagate and make known the new doctrine. A few words are necessary to explain the estrangement of friendly relations between Agassiz and de Charpentier. Agassiz, with his insatiable appetite, and his great faculty of assimilation, digested the whole doctrine of the glaciers, and made use of it, as it was almost his own. He did not want to wrong de Charpentier in any way, but he was so ardent, so impulsive, that he appeared in the eyes of de Charpentier and his friends to be too eager in taking the wind from the sails of others. De Charpentier's manuscript was finished the 31st of October, 1840, and he received Agassiz's "Études sur les glaciers" only three days before, on the 28th of October, and thus had time only to look it over and notice it in his Introduction, pp. vii and viii. As Agassiz continued in his work to maintain his fanciful theory of transportation of boulders, by sliding over the ice-sheet, de Charpentier's objections, pp. 232–241, were timely and to the point.

The "Essai sur les glaciers" appeared a few months later, in February, 1841. Of that work the biographer of de Charpentier says: "The work will remain a classic. Unhappily the modesty of the author induced

him to publish it at Lausanne, which explains why it was so little known in France, in Germany, and other countries, when, if it had been published in Paris, with a simultaneous German edition in a great city of Germany, it would have been one of the most important and at the same time popular books of the time. I cannot better express my admiration for the work than to say that it is impossible to be truly a geologist without having read and studied it" (Dr. H. Lebert, "Biography of Jean de Charpentier").

The following letter from Agassiz to de Charpentier explains the impression made on both by the publication of their two works on the glaciers and the transportation of boulders : —

NEUCHÂTEL, 28 juin, 1841.

à M. J. DE CHARPENTIER,
Directeur des Mines, à Bex.

Mon Cher Monsieur, — Après beaucoup de démarches inutiles j'ai enfin pu me procurer votre ouvrage sur les glaciers, etc. Je l'ai lu avec avidité et j'y ai trouvé beaucoup de faits d'un grand intérêt. Je me suis convaincu de nouveau que nous avons tous encore beaucoup à apprendre sur ce sujet. Je regrette une seule chose c'est que vous ayez si peu mis à profit mes observations, vous auriez pu par là compléter plusieurs points de votre travail et vous donner le mérite de fondre tout ce que l'on sait maintenant de positif sur la question des glaciers, d'harmoniser les dénominations divergentes que vous avez employées, d'établir la synonymie des vôtres avec les miennes, etc. Puisque vous n'y avez pas songé je m'en chargerai et malgré le mauvais vouloir que vous avez mis partout en me citant, vous n'aurez pas trop à vous plaindre de moi, car je tiens avant tout aux progrès de la science sans acception de personnes. J'ai d'ailleurs une masse d'observations nouvelles à publier, recueillies dans les montagnes des Isles Britanniques l'automne dernier et au commencement du mois de Mars de cette année sur le glacier inférieur de l'Aar que j'ai parcouru jusqu'à l'Abschwung.

L'affection que je vous ai toujours conservé me fait regretter pour vous que vous vous soyez donné le tort de critiquer des bagatelles de mes planches et de mon livre, sans citer aucun fait instructif, excepté la température du glacier. Cette réserve est tellement frappante que déjà deux de mes amis m'en ont exprimé leur étonnement. Mais cela s'oubliera j'espère.

Au revoir à Zürich si vous y allez, si non j'espère sur votre territoire un peu plus tard. Mes respects à Mademoiselle de Charpentier. Agréez l'assurance, etc., etc.

Louis Agassiz.

This letter ended the friendly relations between two unusually congenial men of genius, who ought to have remained friends, as workers in the same field and as neighbours. If left to himself, Agassiz would have bridged the chasm; but he was already too much influenced by his secretary and by some others of his collaborators, more or less interested in keeping matters embroiled. After repeatedly hearing Agassiz, and once hearing de Charpentier, I do not hesitate to say that, but for the objectionable surroundings in which Agassiz lived from 1839 until he left Switzerland, the wound would have been promptly healed and friendship renewed.

On the 5th of August, 1840, Agassiz left Neuchâtel for the Grimsel. There he took into his service two of the best Oberland guides, Jacob Leuthold and Jean Währen, the latter a mason by trade, and started at once for the lower part of the glacier of the Aar. The plan was to establish a station on the glacier itself, and for that purpose to make use of Hugi's cabin, found by Agassiz in the preceding year, in a very good state of preservation, as already reported. But to his

astonishment the cabin had disappeared, and it was with some difficulty that Agassiz at last found some of the débris, two hundred feet below the place occupied by the cabin in 1839. After consultation with the guides, who gave the very practicable advice to build a cabin on the rock bordering the left side of the glacier, Agassiz, who was resolved to imitate Hugi, gave all sorts of reasons for establishing the cabin on the median moraine, and finally an enormous block of micaceous slate was selected. A part of the block projected in a sort of roof, under which a wall was built by the mason. Four porters, lent by the housekeeper of the Grimsel's hospice, to carry provisions and bedding, helped in the construction of the cabin, which was inhabited the same evening. The opening of the cabin was toward the south, and a good sketch of it has been published in the "Excursions aux Alpes," by Desor, p. 157. During the night the cabin was christened by the name "Hôtel des Neuchâtelois," which was engraved by the mason in big letters on the block, and the names of the first six occupants were a few days after added. They were Louis Agassiz, Charles Vogt, Ed. Desor, Célestin Nicolet, Henri Coulon, François de Pourtalès, the last two being students at the Neuchâtel Academy.

Observations were begun at once on every point pertaining to glaciers, including structure, motion, tables, moraines, névés, climate and meteorology, red snow, crevasses, etc. Visitors from the Grimsel came now and then; and, to the great joy of Agassiz, one day he saw wending their ways with some difficulty

over the glacier to reach his "Hôtel des Neuchâtelois," his wife, her sister, Fraulein Emmy Braun, and his son Alex., the latter borne on the shoulders of the guide Jacob. That day the dinner on the glacier was particularly luxurious, fresh provisions having come with the visitors, and the pleasure of the unexpected meeting enlivened the otherwise rather rough establishment, with its numerous discomforts.

After a visit to the top of the Strahleck, the party left the "Hôtel des Neuchâtelois," after a stay of only six days, from the 10th to the 16th of August, 1840. Before returning to Neuchâtel, Agassiz traversed the Scheideck, and made observations on the glaciers of Grindelwald, of Schwartzwald, and of Rosenlaui; he visited also the upper part of the glacier of the Aar, and passed a night on the Siedelhorn.

Directly after returning to Neuchâtel, Agassiz left for England. During the meeting of the British Association for the Advancement of Science, in September, at Glasgow, he had an opportunity to see how little progress the glacial question had made among English naturalists: it was almost unknown. Buckland alone, during a protracted visit to Switzerland in 1838, and after resisting as long as he could all the facts concerning glacial action, was at last converted by Agassiz to the new theory. But his conversion had no other effect on English geologists than to bring forward a semi-caricature drawn by Thomas Sopwith, which was largely circulated as a portrait of Buckland dressed in "costume of the glaciers," and which has been reproduced since in "Memoir of Sir Roderick Murchison," by A.

Geikie, Vol. I., p. 309. The reproduction by Archibald Geikie is not, however, a complete one; all the devices and explanations written on the big roller of maps and under the scratched stones have been omitted, and even the title of the semi-caricature has been altered. It is easy to see the reasons for these suppressions and alterations. The mining engineer, Thomas Sopwith, has stated the objections made against the glacial theory in such childish and ridiculous words, that to repeat them was considered by Geikie as reflecting little credit on all those who made fun of the glacial epoch, with Murchison as their leader.[1]

[1] Here is the exact description of the semi-caricature. Buckland, equipped as a glacialist, stands on a flat bit of rock covered with scratches, with the following explanation: "The rectilinear course of these grooves corresponds with the motions of an *immense body*, the momentum of which does not allow it to change its course upon slight resistance." On the polished rocks is written: "Prodigious glacial scratches"; and in order to add to the value of the opposition made by anti-glacialists, the author has engraved, just under the last sentence, "Scratched by T. Sopwith." The title of the drawing is: "COSTUME OF THE GLACIERS." Under his right arm Buckland holds a rather large and long roller, with the inscription on it: "Maps of ancient glaciers." At his feet, on his right side, are drawn: "Specimen No. 1, scratched by a glacier thirty-three thousand three hundred and thirty-three years before the Creation"; and just below, another specimen of a "cailloux strié," marked: "Scratched by a cart-wheel on Waterloo Bridge the day before yesterday." It is now almost incredible that such objections should have been able to elicit anything more than a smile at the ignorance of plain facts.

Philip Duncan was better inspired, when he wrote in his poetic "Dialogue between Dr. Buckland and a Rocky Boulder": —

Boulder, *respondit.*

. . . . . .

"And many a rock, indented with sharp force,
And still-seen striæ, shows my ancient course:
And if you doubt it, go with friend Agassiz
And view the signs in Scotland and Swiss passes."

Murchison, in a letter dated Sept. 26, 1840, in speaking of the Glasgow meeting says: "Agassiz gave us a great field-day on Glaciers, and I think we shall end in having a compromise between himself and us of the floating icebergs! I spoke against the general application of his theory." This was precisely what was to be expected from the English geologists, who are always strongly disinclined to accept any new truth, if discovered by foreigners. Even the Uniformitarians, at that time already very numerous in England, with Charles Lyell as their leader, did not see the splendid opportunity to add a new crown of laurels to Uniformitarianism, or the doctrine of existing causes, and they persisted in getting entangled among masses of floating iceberg.

In company with Murchison, Agassiz visited the North of Scotland to see the Old Red Sandstone and its fishes. During the journey Agassiz found a great number of traces of ancient glaciers, and in vain showed them to Murchison, who, on the 29th of October, wrote to Sir Philip Egerton: "If you have not been frost-bitten by Buckland, you have, at all events, had plenty of friction, scratching, and polishing, before now, and next year you may give us a paper on the glacier of Wyvis and the 'moraines' on which you sport! I intend to make fight." On a question in regard to which he knew next to nothing.

However, Murchison's "fight" amounted to the old rehearsal of the floating iceberg theory and mud currents, two exploded doctrines, rather antiquated even in England after Agassiz's visit of 1840.

On the 4th of November, 1840, Agassiz read before the Geological Society of London his paper "On Glaciers, and the Evidence of their having once existed in Scotland, Ireland, and England" ("Proceed. Geol. Soc. London," Vol. III., pp. 327–332). This memoir — a masterly one — opened a new chapter in the geology of the British Isles. In the "Life of Murchison," by Archibald Geikie, we find the biographer saying (p. 309, Vol. I.) that "the remarkable series of observations by Agassiz among the glaciers of the Alps, and the extension of them to Scotland by Buckland, Lyell, and Agassiz himself," — a sentence which seems to imply that Agassiz came after Buckland and Lyell. The man who with great difficulty, and after a stout and protracted resistance, during a prolonged visit to Switzerland, in 1838, taught Buckland how to recognize traces of ancient glaciers, is represented as occupying only a third place in the discovery of the evidence of the existence of glaciers in Scotland. The truth is, that Buckland, after being converted to the new doctrine, informed Agassiz that he had noticed similar phenomena in Scotland, but had attributed them to diluvial action. He waited until Agassiz came to Scotland, and it was when in his company that Agassiz said, as they approached the castle of the Duke of Argyll, "Here we shall find our first traces of glaciers"; and surely enough, the carriage as it entered the valley rode over an ancient terminal moraine. Then, and not until then, Buckland was made sure that his indications were well based. It is important to add that Buckland did not claim any *priority*. On the contrary, he read his memoir "On the Evidences

of Glaciers in Scotland and the North of England," after Agassiz's paper, and to sustain him by what he had learned in his company during the fall and afterwards. At present, to make amends for their slowness in recognizing old glaciers, the Scotch geologists, with James Geikie at their head, are claiming that they had found evidences of the existence of no less than *five glacial periods* during the Quaternary epoch.

Agassiz's three-months visit in the British Isles during the autumn of 1840 may be counted as his most successful period of happy and important discoveries, and he returned with the great satisfaction of having extended the glacial doctrine to Scotland, the North of England, and Ireland, and having first explained the complicated organization of the fossil flying-fishes of the Old Red Sandstone. The following letter to Humboldt gives an excellent résumé of his three months' exploration: —

Neuchâtel, 27 déc., 1840.

à Son Excellence M. A. de Humboldt.

Mon Cher et Excellent Ami, — Je suis de retour à Neuchâtel depuis huit jours et déjà je me suis remis au travail. J'ai pris la ferme résolution de ne rien faire cet hiver que des "Poissons fossiles" et j'espère achever mon ouvrage avant l'été. Pour y parvenir je ne publierai pour le moment que les mille espèces les plus intéressantes de manière à en faire un corps d'ouvrage lié et je donnerai plus tard dans un Supplément 6 à 700 espèces que je n'ai pas encore complèment étudiées. Mon dernier voyage en Angleterre m'a fait faire des progrès réels en Ichthyologie fossile; j'ai surtout étendu mes observations sur les espèces siluriennes, dévoniennes et houillères. Les genres de l'"Old Red" sont surtout très remarquables. Le prétendu Coléoptère gigantesque de Fifeshire [1]

[1] "History of the County of Fife," by J. Anderson, 4to, Edinburgh.

est un poisson *Pterichthys!* J'ai d'autres types tout aussi extraordinaires *Coccosteus*. Ce qu'il y a de très curieux c'est que tous ces poissons ont des têtes disproportionnées, égalant, dépassant même le tronc en longueur et toujours de beaucoup plus larges, dans le style des Torpiles, mais à charpente osseuse et couverts de larges écussons émaillés. On m'a communiqué en somme environ 250 espèces nouvelles. J'ai également examiné un nombre immense d'Echinodermes. Heureusement que j'ai obtenu des exemplaires de la plupart des espèces, car mon temps n'aurait pas suffi pour les décrire en détail.

Cependant je vous avouerai que ce qui m'a fait le plus de plaisir c'est d'avoir découvert des traces indubitables de glaciers sur une très grande échelle. Les marques de leur présence sont si frappantes que tous les géoloques qui les ont vues sont restés convaincus du fait. Depuis que j'ai rendu compte de mes observations à la Société géologique (de Londres), les mémoires sur ce sujet se succédent. Buckland a décrit ceux qu'il a observé au centre de l'Ecosse et au Nord-Ouest de l'Angleterre ; Lyell ceux du Forfarshire. Pour moi je m'étais surtout appliqué à démontrer qu'ils ont réellement existé dans les Isles Britanniques, après en avoir suivi les traces presque dans toute l'Ecosse, au Nord, à l'Ouest au Centre et au Sud de l'Irlande et dans tout le Nord de l'Angleterre. J'ai retrouvé les mêmes surfaces polies qu'en Suisse, les mêmes moraines latérales et terminales, la même disposition *rayonnante* du centre des chaînes de montagnes vers la plaine, les lacs partout également protégés contre le remplissage par les glaciers qui en occupaient le fond.

Je me suis assuré que toutes les routes parallèles de Glen Roy et de Glen Spear ont été produits par des lacs flottant des glaces et barrés par de grands glaciers dont on voit encore la direction aux traces qu'ils ont laissés au fond des vallées, comme si les glaciers d'Argentière et des Bossons barraient la vallée de Chamounix au-dessus et au-dessous du Prieuré de manière à transformer la vallée en un lac. Le fond de Glen Spear est strié *transversalement*. Le fait le plus extraordinaire, l'absence des deux routes parallèles supérieures dans la partie orientale de Glen Spear se trouve maintenant expliquée !

J'ai accumulé tant de preuves que personne en Angleterre ne

doute maintenant que les glaciers n'y aient existé, et ceux là qui en ont le plus vu ont été convaincu les premiers : Sabine, Sir George Mackensie. Je n'ai trouvé d'opposition que contre l'extension que je leur attribue, encore cette opposition ne s'appuie-t-elle déjà plus que sur l'invraisemblance, quelques uns disent l'impossibilité physique d'un refroidissement temporaire assez considérable pour avoir couvert l'Europe d'une calotte de glace. Cependant j'ai observé mes surfaces polies et stries *jusqu'au niveau de la mer* sur toute la plaine qui s'abaisse d'Enniskillen vers Dublin ; là les stries sont dirigées du N. O au S. E., puis sur la côte occidentale d'Ecosse où je les ai même vu plonger sous la mer, elles vont du N. E. au S. O. dans certaines vallées et du S. E. au N. O. dans d'autres ; sur la côte orientale d'Ecosse elles vont de l'Ouest à l'Est le plus souvent. Dans l'intérieur j'en ai vu qui étaient dirigées du Nord au Sud, et ailleurs d'autres marchant du Sud au Nord. Notez bien que partout la direction des stries et des moraines indique une marche centrifuge, et nulle part un refoulement allant des côtes de la mer à l'intérieur des terres. Impossible dès lors de songer à des courants. Si l'on pouvait penser à un réhaussement du sol, les lacs et les routes paralléles s'y opposeraient, et pour cela d'ailleurs il faudrait un soulèvement simultané des montagnes partout où le phénomène a été observé, ce que la géologie dément.

Les observations paléontologiques de Mr. James Smith de Lardenhill ne contribueront pas peu à établir ma théorie. Il vient de découvrir une faune *arctique*, sur les bords de la Clyde, dans les limons superposés aux détritus des glaciers, à 40, 50, 80 pieds au-dessus du niveau de la mer. Les espèces sont identiques avec celles qui vivent maintenant au détroit de Behring, et différent complètement de celles qui vivent sur les côtes d'Ecosse.

Les observations d'Herschel sur les étoiles variables et périodiques pouront peut-être rendre un jour compte de ce refroidissement.

Je suis désolé d'être obligé de m'occuper maintenant de Poissons fossiles et de devoir laisser vieillir toutes les observations que j'ai faîtes sur ce sujet, tant pendant ma course dans les Alpes au mois d'Août que dans mon voyage en Angleterre, mais je ne céderai pas à la tentation et les "Poissons fossiles" s'achèveront avant que je

retourne aux glaciers, sauf une apparition que je compte y faire au plus fort de l'hiver pour vérifier quelques signaux. Un heureux événement m'a un peu remonté du découragement sous l'influence duquel je vous écrivis de Glasgow. J'ai vendu les dessins originaux de mes Poissons Fossiles,[1] en sorte que j'aurai quelques mois exempts d'inquiétudes.

J'espère que vous avez reçu mes "Études sur les Glaciers"; ne les jugez pas trop sévèrement comme livre; je suis trop peu au courant de ce qui s'est fait en physique pour avoir pu tenir compte de tout ce que l'on sait et éviter les redites; mais du moins j'ai observé avec tout le soin dont j'étais capable et j'ai la conscience d'avoir éloignée toute idée systématique dans l'exposition des faits pour être plus libre de me donner carrière dans le dernier chapitre. Vous me rendriez un grand service en m'écrivant bien franchement ce que vous en pensez quant au fond; j'ai pris l'habitude de profiter des critiques et quand elles viennent d'un ami comme vous, ce sont de véritables bienfaits.

Je vous adresserai par la première occasion les Comptes Rendus des séances de la Société Géologique de Londres, que Buckland m'a remis pour vous et où vous trouverez quelques autres détailes sur la question des glaciers.

Il parait qu'Élie de Beaumont veut s'obstiner à nier même les faits les plus évidents. C'est ainsi qu'il m'affirmait l'autre jour à Paris que les roches polies et striées qui se trouvent *sous les glaciers mêmes* et dont la direction coincide avec le mouvement actuel des glaciers avaient déjà la même apparence *avant* la formation des glaciers. Des masses d'un pareil poids ont donc pu se mouvoir pendant des milliers d'années sur un calcaire aussi mou que celui de la vallée de Rosenlaui sans déranger un atôme de matière!! Puis c'est le courant de l'Ober Hassli qui en bondissant de Meyringen a creusé le lac de Brienz et d'un second coup celui de Thun!! Où donc naissaient tous ces courants alpins pour se verser à la fois au Sud, à l'Est et au Nord avec une vélocité suffisante pour lancer sur le Jura des blocs de 60,000 pieds cubes! M. de Beaumont prétend

[1] Lord Francis Egerton, a relative of Sir Philip Egerton, made the purchase and generously presented them to the British Museum.

que ce sont des débâcles de glaciers ; mais alors ce devraient être des glaciers plus considérables que maintenant et il devait y avoir des glaciers partout où le phénomène des blocs erratiques se présente avec les mêmes caractères qu'en Suisse. Au lieu de réfuter ma théorie ; celle de M. de Beaumont la suppose comme antécédent, c'est-à-dire qu'elle n'embrasse qu'une petite partie du phénomène, celle du retrait successif des glaciers.

Peu s'en est fallu que Murchison ne m'ait dévancé dans la découverte des glaciers en Ecosse. Dans son système Silurien il suppose qu'il a dû exister de grandes étendues de glaces qui auraient charrié les graviers et les blocs soit-disant diluviens, mais il n'a pas songé à en chercher les traces. Et chose curieuse, durant nos discussions personne ne s'est opposé plus obstinément que lui à l'existence des glaciers, qu'il a cependant fini par admettre aussi.[1]

Au moment où j'ai quitté Londres, Buckland partait pour le pays de Galles où je n'ai pu aller et où il trouvera certainement des choses curieuses. Mais j'oublie que l'hiver approche et que déjà vous devez avoir à Berlin plus de glaces que vous n'en voulez sans celles dont je viens de vous charger à profusion. Je n'ose rien vous dire pour M. de Buch quoique je l'aime toujours de tout mon cœur, on m'a dit qu'à Erlangen (Société Allemande des naturalistes) il s'était faché tout rouge contre moi parce que je fais les glaciers assez grands pour fournir de l'eau nécessaire à ses courants.

Adieu, mon bien cher ami, écrivez moi bientôt quelques lignes, vos lettres sont toujours pour moi des trésors, car elles me donnent

[1] It seems that Murchison, a short time afterward, again changed his views, and returned to the floating iceberg and mud current theory; for in his "Geology of Russia," 1845, he rejected "the glacier theory," explaining the Scandinavian drift and erratic blocks in Russia by *traînées* under the sea, made by "moistened masses of drift, under powerful causes of translation"; and in his address at the anniversary meeting of the Geological Society of London, 1842, he says: "The existence of glaciers in Scotland and England is not, at all events, established to the satisfaction of what I believe to be by far the greater number of British geologists." It was not until more than twenty years after Agassiz's visit of 1840, that at last, in 1862, Murchison wrote him that he was wrong in opposing as he did the glacial period. He took time to consider!

ce courage et ce contentement d'esprit sans lesquels on ne fait rien de bon. Ce qui me fait surtout croire que j'ai bien vu en Ecosse, c'est que c'est à vous que je rendais compte mentalement de mes observations.

Votre tout dévoué pour la vie,

LOUIS AGASSIZ.

CHAPTER VIII.

1841–1842.

Visit during the Winter to the Aar Glacier — Letters to Jules Thurmann and to Eugenio Sismonda — "Monographie d'Echinodermes vivants et fossiles" — Letter to Deshayes — Another Letter to Thurmann — Visit of James D. Forbes at the "Hôtel des Neuchâtelois" — Ascent of the Jungfrau — Other Visitors at the "Hôtel des Neuchâtelois" — Forbes at Neuchâtel and La Chaux-de-fonds — Inauguration of the Academy of Neuchâtel, 18th of November, 1841 — Agassiz's Letter to the Rector of the Academy — His Appointment as Rector for the Year 1842–1843 — Controversy with James D. Forbes on the laminated Structure of Glaciers — A New Cabin to replace the "Hôtel des Neuchâtelois" — Stay at the Aar Glacier from the Beginning of July, 1842, to the Middle of September — Discoveries of John Tyndall — Dispute with Karl Schimper — Daniel Dollfus-Ausset.

The winter of 1841 was so rainy at Neuchâtel, and in consequence so much fresh snow fell on the Oberland Alps, that Agassiz was obliged to postpone his proposed visit to the "Hôtel des Neuchâtelois" until the 8th of March. On that day he left Neuchâtel with his secretary, reaching the Grimsel three days later, without very great difficulty. An hour before their arrival, the guardian of the hospice was advised by the movements of his dog, a fine and very large Newfoundland, that some one was approaching. As is often the case in the Alps and mountainous country, the temper-

ature was higher at the Grimsel than at Interlaken. The amount of snow was enormous; the hospice was buried in it; and when the travellers, after a rather exhausting walk, reached the place where the "Hôtel des Neuchâtelois" should have been, they were greatly surprised to see nothing of it but a sort of hump on the crest of snow which covered the moraine. However, after forcing their way around this hump, they found on one side a few feet of the big boulder. It was impossible to enter it without clearing away an enormous mass of snow; so Agassiz contented himself with lying down on the snow, and enjoying the marvellous spectacle around him. The weather was perfect; the air so clear that every topographical feature of the Finsteraarhorn and other peaks was seen with a distinctness unknown during the summer season. The travellers went as far as the Abschwung, then returned to the place of the "Hôtel des Neuchâtelois," where they saw the tops of two very high stakes placed there in the preceding August in holes bored into the ice. Agassiz remained behind with one guide to make several observations with a thermometrograph, and finally returned to the Grimsel, after a journey of twelve hours, from 4 o'clock A.M. to 4 o'clock P.M., somewhat tired, but very happy in his success; for he was certainly the first visitor to the Aar Glacier in the winter season. From the Grimsel Agassiz crossed by Meyringen to Rosenlaui, where he visited the glacier to examine the polishing of the rocks in contact with the ice, and also to determine the quantity of water arising from the glacier. And in regard to the latter point, like de Saus-

sure at the glacier des Bois at Chamounix, he concluded that during the winter the glacier yielded only spring water. A week after leaving Neuchâtel they returned home rather sunburned by their exposure to the intense sunlight on the snow-field they had travelled over.

We have seen in the last letter to Humboldt that Agassiz gathered a large collection of fossil echinoderms during his stay in England in 1840. He had done the same in passing through Paris, and was very diligent in getting specimens from every geologist living among the Jura Mountains, — as Thurmann of Porrentruy, d'Udressier and Parandier of Besançon, and Merian of Bâle. The following letter to Jules Thurmann gives some rather curious details: —

LE 7, 1840 or 1841 ? (date not distinct).

Monsieur, — Voici la première livraison de mes Echinodermes, j'y joins la première des *Études critiques sur les Mollusques*, quoique le texte ne soit pas encore prêt, dans l'espoir que vous aurez peut-être à me communiquer quelques Trigonies ou Myes que je n'ai pas et que je pourrais encore ajouter à mes planches. Le prix des Echinodermes est de 10 francs, je réclamerai celui des Mollusques en vous envoyant le texte.

Je viens de faire demander à M. Nicolet les deux premières livraisons de Sowerby, la 3ième est très avancée ; le prix de la livraison coloriée est de 10 francs. M. Nicolet vous enverra lui-même par occasions les livraisons.

Je pense que vous apprendrez avec plaisir que Gressly a repris son activité d'autrefois ; j'ai reçu depuis peu plusieurs bonnes lettres de lui. Excusez-moi de tant tarder de vous envoyer mes moules ; j'ai encore eu des chagrins de famille cet hiver qui m'ont fait passer plusieurs semaines en Allemagne et singulièrement dérangé mes affaires ; dès que je le pourrai je réparerai mes torts.

Votre très dévoué serviteur,

AGASSIZ.

The following is another letter written about the same time: —

MONSIEUR EUGÈNE SISMONDA,
assistant au Musée royal de Minéralogie, Turin.

Monsieur et très honoré collégue, — De retour d'Angleterre après une absence de près de quatre mois j'ai le plaisir de recevoir votre aimable lettre. Je suis charmé d'entrer en relation directe avec vous, qui par vos beaux travaux géologiques avez si puissament contribué à l'avancement de la science. Il y aura tout profit pour moi à soutenir une correspondance suivie avec vous. J'accepte avec plaisir votre proposition d'échange; je puis vous remettre au moins 600 moules d'Echinides fossiles accompagnés d'un catalogue systématique et d'une caractêristique des genres nouveaux que j'ai établis. Je recevrai volontiers en échange des coquilles, des Zoophites et des Echinides de tous vos terrains d'Italie, même les espèces les plus communes. Je désire beaucoup obtenir des séries d'exemplaires de différents ages.

Dans des échanges de ce genre j'ai généralement demandé un fossile contre un moule à raison des frais considérables que leur exécution m'a occasionné, sans compter jamais rigoureusement, comme cela convient entre gens qui doivent avoir en vue les intérêts de la science plutôt que la dépense qui en résulte pour eux. Outre ces moules d'oursins j'en posséde beaucoup de Mollusques, de Poissons, de Mamifères et 5 à 600 espèces de Mollusques des terrains secondaires en nature, dont je puis disposer pour échanges. C'est assez vous dire que j'ai d'amples matériaux pour des envois considérables et j'attends seulement pour vous expédier une premiére caisse qui peut être préte dans trois jours, que vous vouliez bien me dire quel nombre d'exemplaires vous avez de disponible, ou plûtot quelle étendue vous désirez que je donne à mon premier envoi.

Je suis très flatté de la dédicace que vous me faites d'un de vos Echinides et je me réjouis à l'avance d'apprendre à le connaître.

Agréez, Monsieur, l'assurance de ma considération, très distinguée.

LS. AGASSIZ.

NEUCHÂTEL EN SUISSE,
le 24 décembre, 1840.

We have in these two letters a glimpse of Agassiz's method of collecting specimens, making exchanges, and disposing of his publications.

The success of the "Fossiles du terrain crétacé du Jura Neuchâtelois," of the "Prodrome d'une Monographie des Echinodermes," and of "Echinodermes fossiles de la Suisse," all published at the expense of the Société des Sciences Naturelles de Neuchâtel and of the Société Helvétique des Sciences Naturelles, led Agassiz to undertake, at his own expense, the publication of "Monographies d'Échinodermes vivants et fossiles," with many beautifully executed plates. It was an unfortunate undertaking, very expensive on account of the great number of plates, and without proper patronage from naturalists to make it profitable. Only four monographs or "livraisons" were issued between 1838 and 1842. The first, on "Salénies," 1838, shows good work, and is very creditable in all respects, and worthy of the name which signs it; the second, on "Scutelles" (July, 1841), although containing many new facts and an interesting history of the progress of the natural history of the echinoderms, besides twenty-seven most exact and beautiful plates, did not attract much attention; while the third "livraison," containing the "Galerites" and "Dysaster" (1842), is by E. Desor. Agassiz helped in the revision of the proof-sheets; but, on the whole, the work shows a noticeable inferiority to all the previous publications on the echinoderms.

The fourth "livraison" (1842), the manuscript of which was written in German and translated into

French, treats the anatomy of the genus Echinus, and is by Professor G. Valentin of Berne; and its nine plates, several of them double, are remarkably well drawn by Dickmann. After the issue of the fourth "livraison," the publication was stopped and never resumed. This fine work, forming a large 4to volume, is dedicated to "M. Valenciennes, Professeur de Zoologie au Jardin des Plantes et à M. Paul Deshayes, Professeur de Conchyliologie à Paris." In this way Agassiz tried to conciliate two naturalists, who had nothing in common except a disagreement in regard to an appointment obtained by pure favour for Valenciennes, against all justice and the right claim of Deshayes. For, through the influence of Humboldt and the help of Agassiz, Valenciennes was elected professor of conchology and zoöphytology at the Jardin des Plantes, — a most unfortunate choice, for he knew next to nothing of these two difficult branches of invertebrate zoölogy, having only a knowledge of living fishes, obtained as an assistant of George Cuvier; while Deshayes, on the other hand, was regarded by every naturalist, not only in France, but also in other countries, as the ablest conchologist of his time.[1] Agassiz, hoping to mend matters and to help in healing the wound inflicted on Deshayes, conceived the strange notion of uniting in a dedication the two names of Valenciennes and Deshayes, placing Valenciennes before Deshayes. He very well knew that he was

[1] Thirty years later, in 1869, Deshayes was at last appointed Professor of Conchology at the Jardin des Plantes, at the ripe old age of seventy-two years, an act of justice due to M. V. Duruy, then Secretary of Public Instruction.

treading on dangerous ground, as the following letter to M. Deshayes shows: —

NEUCHÂTEL, le 27 février, 1839.

Monsieur, — Désirant vous donner un témoignage public de ma reconnaissance pour les communications importantes que vous m'avez faîtes sur les oursins fossiles, j'ai pris la liberté de vous dédier conjointment à M. Valenciennes à qui je dois également des communications d'une haute valeur, l'ouvrage sur cette classe d'animaux, dont je viens de publier la première livraison.

J'espère, Monsieur, que vous daignerez accepter cette marque de mon estime et de mon amitié. La science vous doit de si importants travaux, trop peu récompensés, dans l'atmosphère où vous vivez, pour que je ne puisse pas espérer trouver de la sympathie chez un homme qui poursuit ces recherches avec un tel désinteressement. La deuxième livraison, qui est très avancée, contiendra les Scutelles. Je profiterai de toutes les occasions que j'aurai pour Paris pour vous retourner vos exemplaires au fur et à mesure qu'ils seront dessinés. j'y joindrai les moules des espèces que vous n'avez pas et si vous le désirez de celles des vôtres que j'ai pu faire mouler sans risque de les endommager. Ils pourraient vous servir à faire des échanges. Veuillez me dire si vous désirez que je vous en fasse couler des épreuves.

Je vous adresse également la première livraison encore inachevée d'un ouvrage que je prépare depuis longtemps sur les Mollusques fossiles de la Suisse principalement, dans lequel je me propose de traiter aussi différentes questions générales de Conchyliologie et surtout celle de la délimitation des genres et de l'analogie des espèces fossiles avec les espèces vivants. Quoiqu'envisageant, comme vous le savez ces questions un peu différemment de vous, la base sur laquelle j'ai travaillé n'en est pas moins la même et c'est là un point de ralliement infaillible l'étude consciencieuse et comparative des faits. Qu'après cela il me paraisse plus utile de grouper les espèces d'après leurs caractères plus restreints en petites groupes, que de les réunir d'après des caractères plus généraux en grands genres, c'est une question à débattre ultérieurement et le résultat auquel on s'arrêtera ne changera en rien la valeur des observations spéciales.

La définition et la circonscription des espèces touche déjà de plus près à l'importance actuelle que l'on attache à ce genre de travail. Il me paraît à cet égard que la facilité de distinguer telle ou telle série de formes diverses ne peut pas être un motif absolu pour les réunir ou les séparer et qu'il importe de rassembler les matériaux les plus complets sur la généalogie de chaque type avant de pouvoir se prononcer d'une manière invariable. C'est ainsi que la possibilité de rattacher à une souche primitive les générations actuelles souvent diverses de telle ou telle espèce fait que nous ne les séparons pas comme autant d'espèces distinctes, bien que souvent les individus que nous réunissons ainsi diffèrent d'avantage entre eux que ceux d'autres types que nous séparons à cause de la fixité de leurs caractères. Ces principes de la zoologie actuelle me paraissent devoir influer ultérieurement sur notre manière d'envisager l'analogie des espèces fossiles avec les vivantes. Je crois par exemple que s'il pouvait être démontré géologiquement que certaines espèces fossiles que nous envisageons comme identiques avec les vivantes, ont cessé d'exister dans des circonstances telles qu'il serait impossible qu'elles aient pu se reproduire par voie de génération dans l'époque suivante, il faudrait alors envisager ces analogues d'une autre époque comme des espèces particulières procréez dans d'autres temps alors même que leur ressemblance extérieure rendrait leur distinction très difficile. Il me semble qu'en pareil cas le fait que les extrêmes des variétés d'un type fossile se lient aussi étroitement aux extrêmes d'un type vivant que leurs variétés entr'elles n'emporte pas la nécessité de la réunion des deux types en une seule espèce. Quoique cette manière de voir ne s'accorde pas en tous points avec certains principes que vous avez établis sur la détermination des espèces, ils ne me paraissent infirmer en aucune façon l'importance des faits innombrables que vous avez receuillis sur l'analogie des espèces fossiles avec les vivantes, puisque vous avez toujours signalé les particularités qui distinguent toutes les variétés que vous avez réunies dans le même type spécifique. Je pense dès lors que vous ne répugnerez pas à faire part vous même occasionellement de ces observations à la Société Géologique (de France).

La première livraison de mes "Études critiques" paraîtra dans le courant de l'été. En parcourant ce que j'ai pu vous en envoyer

dès aujourd'hui, vous remarquerez sans doute que j'ai pris toutes les précautions possibles pour éviter de multiplier les espèces sans raison; ainsi pour les Trigonies j'ai représenté une série de tous les âges de la *Trigonia navis* (du Lias Supérieur de Gundershofen, Haut Rhin, recueillis par Gressly) pour prouver que quelques espèces nouvelles que j'ai établies n'en sont pas les jeunes. Quant à la famille des Myes elle a eu des représentants bien plus nombreux et plus variés dans les terrains jurassiques, qu'à des époques plus récentes, et la diversité des types que j'ai étudiés m'a engagé à grouper des espèces (qui cadraient fort mal dans les genres admis maintenant) dans plusieurs genres nouveaux dont je donnerai très en détail les caractères distinctifs en les comparant soit entr'eux, soit avec des genres qui ont des représentants maintenant.

Si votre Conchyliologie continue à paraitre régulièrement j'attendrai que vous ayez publié les Myes pour émettre ma Monographie. Je suis enchanté des deux livraisons qui ont déjà paru.

Je vous adresse enfin les premières planches d'un Mémoire[1] que je vais insérer pour paraître incessamment dans le second volume des Mémoires de la Société d'Histoire Naturelle de Neuchâtel. Je pense que cette publication sera utile pour la détermination des moules fossiles. Si vous désirez les avoir en plâtre, je vous les enverrai, mais comme ils appartiennent à notre Musée, vous m'obligerez de m'envoyer en échange des fossiles ou des coquilles vivantes. Dans ce cas je vous indiquerai ce qui nous manque surtout.

Agréez, Monsieur, l'assurance de mon parfait dévouement,

Ls. Agassiz.

This is one of the most important scientific letters written by Agassiz, showing the direction of his mind and his preconceived ideas on a subject which he advocated, more or less, during his whole life, in regard to species and genera, and also the erroneous notion of the confinement of species to each group of formations,

[1] "Mémoire sur les Moules de Mollusques vivans et fossiles, première partie; Moule d'Acéphales vivants." 4to, 1839.

against the plain facts brought forward by Deshayes, demonstrating the passage of species from one group to another, illustrated so vividly in the great Tertiary epoch of the Paris basin. In palæontology Agassiz was an absolutist until the last two years of his life, when he abandoned the rigidity of his principles in his celebrated prophetic letter to Benjamin Pierce on the supposed existence of Ammonites, Trilobites, and other lost forms of marine animals at great depths. These two errors are the most remarkable examples of the excess of his imagination.

Another scientific letter, written at the same time to Jules Thurmann, is too good not to be given in full.

NEUCHÂTEL, 12 février, 1842.

MONSIEUR JULES THURMANN
à Porrentruy.

Monsieur, — Gressly m'a fait le plaisir de me communiquer la lettre que vous lui avez adressée tout récemment. Je me réjouis infiniment d'apprendre que vous vous êtes remis avec ardeur à la Géologie, et que vous étudiez maintenant sérieusement les fossiles. Je vous remercie infiniment pour ma part des détailes circonstanciés dans lesquels vous êtes entré sur les oursins, et rien ne me serait plus utile et agréable que de recevoir vos observations sur les autres parties de mon travail. Soyez persuadé, Monsieur, que j'apprends bien davantage des remarques de ce genre, que les compliments d'une banalité affligeante, que les auteurs s'adressent si souvent. Je ne puis même vous prouver l'importance que j'y attache, qu'en répondant à vos remarques.

Une chose m'a frappé, c'est que mes coupes génériques vous aient satisfaits. À ce sujet, je suis de la part des Zoologistes en bute à des reproches continuels : on me répéte sans cesse que je les multiplie à plaisir. Quant à moi j'ai la conviction que l'on ne parvient bien à étudier les espèces, qu'en les groupant dans des genres

aussi restreint que possible ; sauf, peut-être à en réunir plus tard plusieurs sous un même chef, si l'on découvre des types intermédiaires.

Quant aux espèces je partage pleinement les *principes* que vous énoncez, je les professe hautement ; je dirai même que ce sont ces principes qui me dirigent dans mes études ; mais je diffère surtout de vous dans leur *application*. Ayant égard à ce qui a eu lieu dans les autres branches de la science, lorsqu'elles étaient dans leur enfance, je cherche à réunir le plus de matériaux possible, et après avoir comparé exactement, je distingue et distingue, faisant valoir les moindre différences que j'aperçois, établissant des espèces souvent d'après un seul exemplaire imparfait, sauf à réunir, quand on a rassemblé des matériaux suffisants pour le faire à bon escient ; c'est la marche que la science a suivie dans toute son histoire. Ce travail de critique a ses inconvénients, je le sais ; il oblige de revenir sur les mêmes matériaux à plusieurs reprises ; mais il a ses grands avantages, c'est de forcer à un examen scrupuleux, tous ceux qui réunissent des matériaux nombreux sur une seule espèce. Il forcera les collecteurs à ne pas disséminer à l'infini leurs exemplaires et à collecter des séries et non pas des échantillons. Vous verrez que toutes les fois qu'il m'a été possible d'étudier des séries d'exemplaires, j'en ai analysé toutes les formes, distingué des variétés d'âges, de station, etc. Vous reconnoissez vous-même, que nos collections sont trop pauvres pour nous permettre de faire cela, pour un grand nombre d'espèces dès à présent. Le terme désirable n'est donc pas encore à notre portée, et voilà pourquoi je procéde si différemment de la plupart de mes collègues dans l'application des principes incontestables. Pour les mêmes raisons j'ai fréquemment établi des genres dont je n'ai longtemps connu qu'une seule espèce.

Maintenant vous possédez des séries d'espèces dont je n'ai vu jusqu'ici que des exemplaires isolés ; c'est une bonne trouvaille et si vous voulez bien me les communiquer au complet, c'est-à-dire la masse des bons exemplaires je serai le premier à supprimer celles de mes espèces qui forment double emploi. Mais avouez, qu'il était plus profitable à la science, que c'était du moins fixer les yeux ou l'attention d'une manière bien plus pressante sur ces oursins, en établissant le genre *Pedina* et en y distinguant plusieurs espèces

qu'en les réunissant sous un seul nom dans le genre *Echinus*. Supposons un instant, qu'au lieu de devoir les réunir, en partie du moins, comme cela me paraît probable, d'après ce que vous écrivez à Gressly, les ayant d'abord réunis, quelqu'un eut trouvé que l'on confondait plusieurs espèces sous le même nom. La vraie difficulté qui se serait alors présentée eût été de savoir à laquelle, il faut conserver le nom primitif; puis si cette espèce est établie depuis longtemps, s'assurer laquelle des deux est mentionnée dans les différents auteurs; puis effacer toutes les citations de localités déjà mentionnées, parce qu'on ne sait plus, quelle est celle qui provient de l'endroit A. ou de l'endroit B., etc. C'est-à-dire que c'est à *la crainte d'établir trop d'espèces*, sur des matériaux incomplets, qu'il faut attribuer tout cet effroyable dédale de la synonymie, et des fausses citations de gisements, qu'on ne peut éviter qu'en s'abstenant complètement, ce qui ne fait faire aucun progrès, ou en distinguant et distinguant toujours jusqu'à ce qu'on puisse réunir à coup sûr.

N'en n'a t'il pas été ainsi de tous nos oiseaux aquatiques, dont les jeunes et les vieux ont passés pour des espèces distinctes, même aux yeux de Linnée? C'est cette manière d'agir qui m'a conduit à établir bien des espèces, qu'il faudra peut-être supprimer un jour. J'ajouterai encore que c'est faute de posséder moi-même une grande partie des objets que je décris, que je suis forcé de faire faire les planches, pendant que ces objets sont à ma disposition et souvent de les numéroter d'A. B. C. et de faire pire encore. Aussi si nous nous voyons plus souvent, m'entendriez vous souvent répéter qu'il ne faudrait jamais publier que la seconde édition de ses œuvres et toujours canceller la première après en avoir fait part à ses amis seulement. Nous ne marcherons avec une entière assurance en paléontologie, que quand on possédera autant d'éditions d'un genre complet du Règne Animal, qu'il y a d'éditions de "Cornelius Nepos" ou de la grammaire latine de Bröder, ou de tel dictionnaire de poche.

Gressly, Desor et moi nous travaillons aussi assiduement que possible à la paléontologie; ces Messieurs vous écrivent chacun de leur côté; j'ai voulu aussi vous donner un signe de vie, et j'espère que nous n'en resterons pas là. Jent [l'éditeur d'Agassiz à Soleure] ne peut pas vous avoir adressé les planches de Myes, puisqu'il ne

les a pas encore. Ce sera Gressly ou moi qui vous les auront fait parvenir, afin d'apprendre de vous, si vous aviez quelque chose de neuf dans ces genres. Vous m'obligerez infiniment en en faisant une petite caisse et en me l'adressant avec vos oursins. Nous déterminerons cela en commun, et Gressly ou Desor vous renverra prochainement le tout.

Agréez, Monsieur, mes salutations très empressées.

Ls. Agassiz.

Seldom has Agassiz written such an important scientific letter, showing as it does his method of determining species and establishing new genera. In it he anticipates the criticism which has been made since, that he created too many species; for instance, of fossil fishes from the *flysch*[1] of Glaris, some of which were distorted by strong lateral pressure. A larger number of specimens than were then at his disposal have since proved his mistake.

At the meeting of the British Association at Glasgow during September, 1840, James D. Forbes, professor of natural philosophy in the University of Edinburgh, took such an interest in all the communications made by Agassiz on the glacial question and the glaciers, that Agassiz very politely tendered him an invitation to visit him the next summer at his "Hôtel des Neuchâtelois."

On the 8th of August, 1841, Agassiz, with his assistants, again occupied their old and rather rough quarters on the Aar glacier; and there Forbes, accompanied by a Scotch friend, Mr. Heath, was received as a welcome guest. Agassiz was delighted to have a physician so celebrated as Forbes to examine his observations. He showed him everything — all the experiments they were

[1] A lithologic term used in German Switzerland to designate a series of strata belonging to the Tertiary Eocene.

making in regard to temperature, progress of the moraine, etc., often asking his opinion and advice. But Forbes was as silent as a sphinx; it was impossible to draw from him a single remark or hint. This impenetrability in a savant was new to Agassiz, who, until then, had more or less easily charmed every scientific man with whom he had come in contact. But this time he had found one who would not yield to his ingenuousness. During the three weeks spent by Forbes at the "Hôtel des Neuchâtelois," he observed everything around him, but said absolutely nothing, even as regards his impressions. Agassiz's desire to study the structure of glaciers led him to bore in the glacier a hole 140 feet deep; and he was also lowered, supported simply by a rope, to a depth of 120 feet, into an old "moulin" or well, to see how far through the glaciers the laminated structure extended. This veined structure was the only point referred to by Forbes during his stay at the "Hôtel des Neuchâtelois." It had been observed previously by David Brewster, Hugi, Bishop Rendu, Guyot, and Agassiz; but Forbes afterward claimed that it was he who first called Agassiz's "attention to the fact that the ice of glaciers is composed of vertical laminæ, constituting a true ribboned structure,"[1] and raised a controversy, of which we shall speak farther on.

Several peaks were ascended by Agassiz during Forbes's stay, among them the summit of the Ewigschneehorn; with a visit to the Gauli glacier, a walk over the "mer de glace de Viesch," and, finally, an

[1] "Edinburgh Philosophical Journal," January, 1842.

ascent of the Jungfrau. Until then no tourist had succeeded in reaching the top of the Jungfrau. During the last two years Agassiz had often discussed with his favourite guide, Jacob Leuthold, the means of reaching that virgin peak, the great landmark of the Bernese Oberland.[1] On the 27th of August, Agassiz with Forbes, Heath, Desor, and two others, and six guides, left the Grimsel at four o'clock in the morning, arriving at six o'clock P.M. at the Meril Chalets, near the lake, where they were well received by the herders, who were rather astonished at the arrival of such a large party.

Next morning, at five o'clock, they left Meril, aiming for the Aletsch glacier; after a fatiguing walk on rather slippery ground, among "crevasses" and over snow fields, the party reached the base of the last slope at three o'clock P.M. Four of the party had been forced by fatigue or giddiness to remain behind; but the other eight — one after another in turn — gained the summit, which is only two feet long by a foot and a half broad. Agassiz was the first, then Desor, Forbes behind, and a French tourist, M. Duchâtelier of Nantes, fourth. At four o'clock the descent began; and they arrived all safe at half-past eleven P.M. at the Meril Chalets. Three days later Agassiz was again at the "Hôtel des Neuchâtelois," where he found his artist-friend, Burkhardt, and his assistant, Charles Girard, anxiously awaiting his return.

[1] The two brothers, Rudolph and Jerome Meyer of Aarau, in 1811 and 1812, made two ascents of the Jungfrau with success, although the fact is contested by the mountaineers of the country. At all events, a party of guides, with J. Baumann as chief, succeeded in reaching the summit on the 8th of September, 1828.

During the five weeks' sojourn of Agassiz and his friends on the glacier of the Aar, from the 8th of August to the 10th of September, 1841, many visitors were received besides Forbes. The title of "Hôtel des Neuchâtelois" deceived several tourists, who, hearing of it at the Grimsel Hospice, came up expecting to find some establishment like the "Culm Hotel" on the Rigi. Even a Scotch lady, Mrs. Covan of Edinburgh, in returning from an ascent of the Finsteraarhorn, stopped and was entertained as well as it was possible by Agassiz. Most of these visitors were obliged to return to the Grimsel to find lodging, or to be contented with a corner in the guide's cabin. The hospitality of the "Hôtel des Neuchâtelois" was reserved for savants or personal friends, such as General de Pfuel, the Prussian governor of Neuchâtel, Lord Enniskillen of Ireland, the two de Rougemont of Neuchâtel, the geologists, Studer and Escher von der Linth, the meteorologist and botanist, Charles Martins, Bravais, Guyot, etc. However, the solidity of the block forming the roof was beginning to awaken suspicion; cracks had become alarmingly numerous, and when it rained, the interior of the hotel was almost a pond, with water running in every direction. It was only a question of time when the enormous block would break in pieces, and it was also feared that a sudden move of the glaciers might hasten the catastrophe. So every evening before retiring one of the party used to make the round of the cabin to see that all was right. Although not in immediate danger, it was resolved to abandon the "Hôtel des Neuchâtelois" and to erect next year a new cabin; not,

as formerly, on the glacier, but on firm ground, and hence less exposed to dangerous accidents.

Forbes, after his return from the ascent of the Jungfrau, visited parts of the Valais and Chamounix, and by the middle of September arrived at Neuchâtel. His reception by Agassiz was most cordial; and Agassiz's letter introducing Forbes to his good friend, Célestin Nicolet, may be quoted as an evidence of his solicitude to help him in every way.

NEUCHÂTEL, le 20 septembre, 1841.

Mon cher ami Nicolet. — C'est M. le Professeur Forbes qui vous remettra ces lignes et que je vous recommande tout particulièrement en vous priant de lui faire voir ce que vous avez d'intéressant à la Chaux-de-Fonds, en fait de Sciences et d'Industrie. Je suis sûre que vous aurez beaucoup de plaisir à faire la connoissance d'un homme aussi haut placé dans le monde savant que M. Forbes.

Venez bientôt causer un peu plus intimément avec nous de tout ce que nous avons vu dans les Alpes; plus vite et mieux.

Tout à vous

LS. AGASSIZ.

Although the Neuchâtel Academy was founded in 1838, the public inauguration of the new institution was delayed until the 18th of November, 1841. Agassiz on that occasion, wearing the cross of the Red Eagle of Prussia, delivered an address, "De la Succession et du développement des êtres organisés à la surface du globe terrestre dans les différents âges de la nature," in which he says, "Si le cours des astres ne nous présente aucune variation, si l'ordre des saisons est immuable, si la reproduction des espèces s'opère toujours de la même manière, il est évident que le cours de ces phénomènes

est invariablement réglé et suit des lois naturelles, indépendantes de l'influence créatrice qui les a établies."

Objections were raised by the rector of the academy and some of the professors; and after discussion, it was resolved that two hundred separate copies of Agassiz's address should be printed for his own use, and four hundred copies of the three speeches delivered at the inauguration, as part of the programme and annual report of the academy. The pietist party was very strong then in Neuchâtel, and several sentences in Agassiz's address were considered as anti-orthodox and antagonistic to the prevailing creed of the Neuchâtel ministers. The following letter from Agassiz to the rector shows the intensity of the commotion produced: —

NEUCHÂTEL, 14 décembre, 1841.

Mon cher collègue [le recteur Pétavel]. — Considérez, je vous prie, que mon discours s'adresse au public de l'Académie et que peu m'importe le jugement de ceux qui sont incompétents ou incapables. Que serait notre Académie si elle devait se mettre à la hauteur de tous ceux qui en veulent? Vous auriez pu voir vendredi que je fais de vos réclamations une affaire de principes et que je suis parfaitement décidé à ne pas faire la moindre concession, parce que j'y verrais une atteinte fatale à la liberté d'enseignement et parce que je tiens à ce que notre Académie aie de la tenue et qu'un de ses membres ne dise pas blanc aujourd'hui et noir demain. Ne confondez pas votre position avec la mienne; vous deviez parler au nom du corps académique et c'est ce qui nous donnait à tous le droit d'exiger que vous parleriez dans tel ou tel sens, dans celui de la majorité, sauf à vous de donner votre démission comme Recteur, s'il ne vous convenait pas d'être l'organe de notre pensée: Vous ne faites pas assez cette distinction. J'ai parlé pour moi et dans l'intérêt de notre Académie; je ne souffrirais pas la moindre critique de ce que j'ai fait et dit; je vous le répéte sans la moindre ani-

mosité; je dirai même que je le fais comme si j'étais tout à fait étranger à la discussion et uniquement parce que vous me demandez comme Recteur: quel bien je pense que cela fera à l'Académie, et parce que me faisant le défenseur de cette indépendance de l'esprit, sans laquelle rien ne grand ne peut prospérer, je dois vous rappeler que le Recteur est tenu de rester étranger à tout cela. S'il en était autrement, ce seraient des antécédents qui donneraient accès au cœur même de l'Académie à des influences étrangères, que je ferai toujours tous mes efforts d'en bannir et auxquelles il faut fermer la bouche dès le commencement pour qu'elles ne réitèrent pas leurs tentatives. Je vous l'ai dit dans mon discours et je vous le répète ici: il est peu de grandes vérités qui n'aient été traitées de chimères et de blasphèmes, avant qu'elles fussent démontrées. Heureusement que les temps de Galilée n'existent plus; mais aussi y a-t-il bien moins de mérite qu'alors à ne pas composer avec les prétentions des *Ministres de l'Église*, et ce n'est certes pas une couronne de martyr que j'espère conquérir. Je dis "de l'Église," et par là j'entends les ministres de *tous* les cultes, qu'ils soient protestants, catholiques, juifs ou mahométans, *qui ne veulent faire de progrès en rien*. Notez bien que je ne vous dis pas "de la Religion." N'oubliez pas que mes doctrines ne peuvent porter d'atteinte qu'à l'enseignement des docteurs de l'Église et nullement aux vérités de la Religion.

J'en reviens à mon discours. Ennuyé de toutes ces discussions, je le livrerai aujourd'hui à Wolfrath (l'imprimeur) sans notes, tel que je l'ai lu, sans y changer quoique ce soit. Si on ne me laisse pas tranquille à ce sujet, ce sera ma meilleur défense.

Agréez, mon cher collègue, mes salutations bien empressées; croyez que j'estime votre zèle pour les convictions que vous professez maintenant. Soyez persuadé que jamais je ne chercherai de discuter sur ces matières, que je désire avant tout vivre en paix avec mes convictions et pouvoir poursuivre sans relâche mes recherches, ne réclamant en leur faveur que la même tolérance que je concède à tout le monde.

Ls. Agassiz.

This is the most decisive letter ever written by Agassiz. At that time Neuchâtel was entirely in the

hands of the "Ministres de l'Église"; and the Pietists and even the "Momiers" largely controlled Neuchâtel society. Some of Agassiz's most intimate friends, like Arnold Guyot, were among the leaders of the Pietists, and it required considerable moral courage to resist the anti-liberal pressure exerted by the sect against all liberal, even scientific ideas. This controversy is the best answer to the attacks of those who have pretended that Agassiz came under the influence of the Methodists in America. Agassiz, on the contrary, was most liberal in religion, and always took care never to confuse science with religion. All his life he kept free of the "Ministres de l'Église," both in Europe and in America. To tell the truth, he never liked "ministers," to whatever sect they might belong. To finish this incident, Agassiz was appointed rector of the Neuchâtel Academy for the year 1842–1843; and in his "Discours du Nouvel-An," the 1st of January, 1843, he said: —

Une institution aussi jeune que notre Académie a surtout besoin de l'appui d'un monarque qui veille avec une si constante sollicitude aux intérêts de la science. Déjà avant son avènement au trône Frédéric-Guillaume IV était le protecteur le plus zélé des sciences en Prusse, et sous son règne les institutions scientifiques du royaume brillent d'un nouvel éclat, dû surtout à l'empressement avec lequel le roi a appelé dans ses États les hommes les plus éminents de l'Allemagne dans le domaine de la philosophie, des sciences, du droit et des lettres. Tout récemment encore, il a inauguré l'œuvre d'une grande reconciliation religieuse. C'est lui qui a brisé de vielles entraves qui pourraient gêner un nouvel élan de l'intelligence pour agrandir les limites d'une libre expression de la pensée, tout en la contenant dans de sages bornes.[1]

[1] "La première Académie de Neuchâtel," par Alphonse Petitpierre, pp. 128–129, Neuchâtel, 1889.

In his agenda, Agassiz wrote the same day: "Présenté comme Recteur les hommages du corps académique au Roi. La réponse du Président du Conseil d'État me fait supposer que les paroles modérées que j'ai prononcées ont déplu." After a second thought, and on the advice of the governor, General de Pfuel, representing the king of Prussia, the matter was dropped.

The year 1842 began with a difficulty with James Forbes, ended with one with Karl Schimper, with the erection of a new and rather too costly establishment at the glacier of the Aar as an interlude, — three things which might have been avoided to the advantage of Agassiz. On the 26th of February his secretary, who by this time had become hardly inferior to Agassiz, wrote a rather sharp and irritating letter to Forbes, relating to the question of priority in the discovery of the laminated structure of the glacier. Desor, by inclination and education, was always ready for a controversy or a discussion on any point scientific, political, or religious. He had learned enough of law, when a student, to assimilate the spirit of the advocate. He became a naturalist by accident, and as a means of supporting himself. But his proper sphere was politics; and as soon as he became unexpectedly rich, he devoted almost all his time to politics; as his biographer says: "He was persuaded, at the end of his life, that on his shoulders rested the welfare of the Swiss Confederacy, of the Neuchâtel Canton, and of the federal Polytechnicum. He passed all his time in writing polemic articles in newspapers, compromised himself in petty personal discussions, and founded a newspaper to advocate and

maintain his ideas and regain his political position, promptly lost by his own fault. In the end, his newspaper was reduced to only one hundred subscribers; and the fatigues he incurred to maintain his political views in a great measure brought on the fatal illness which carried him off at Nice, the 23d of February, 1882."

The beginning of the controversy with Forbes is recorded in the following letter from Agassiz, addressed to Mr. Murray's son in London, who was the editor of the "Annals and Magazine of Natural History."

NEUCHÂTEL, 13 février, 1842.

D'après votre lettre je présume que c'est Forbes qui vous a offert un article sur les glaciers; si c'est lui ce serait une raison de plus pour moi de vous prier d'attendre mes notes, car je viens de recevoir une notice de lui insérée dans le Journal de Jameson (*Edinburgh New Philosophical Journal*) qui me paraît la plus complète indiscrétion dont on puisse se rendre coupable envers un ami. Mr. Forbes à mon invitation est venu passer trois semaines dans la cabane que j'avais fait établir sur le glacier de l'Aar, je lui ai fait voir tout ce que la glacier offre d'intéressant, toutes les recherches ont été suivies sous ses yeux. Dès le premier jour je lui ai même annoncé que l'un des points que je me proposais spécialement d'étudier était la structure intime du glacier et particulièrement les apparences rubannées du glacier que j'avais à peine mentionnées dans mon ouvrage ("Études sur les Glaciers"), p. 121, en en décrivant l'aspect extérieur, parce que depuis 1838 où je les avais pour la première fois remarquées sur la mer de glace de Chamounix je n'étais point encore parvenu à en suivre tous les détails, ce phénomène n'étant pas toujours également distinct. Comme cette année il a été facile de l'observer, nous en avons fait une étude détaillée et dès les 3 octobre, 1841, j'en donnai la description à M. de Humboldt, alors à Paris, qui en fit part à l'Académie (des Sciences de l'Institut de France), et voilà qu'en décembre (*Edinburgh New Philosophical Journal*, January, 1842), Mr. Forbes en

fait part à l'Académie d'Edinburgh en s'en appropriant la découverte et en poussant l'impudence jusqu'à dire qu'il fut surpris en visitant le glacier de l'Aar de voir en me parlant de ce phénomène que je ne le connaissais pas. Veuillez à ce sujet comparer la page 121 de mon livre. Il faut absolument que je fasse connaître ces faits pour ne pas paraître plus tard plagiaire dans mes propres observations, et je vous prie de communiquer le contenu de cette lettre à tous ceux de mes amis que vous connoissez et que cela peut intéresser. Ceci est une raison de plus pour activer la redaction de mes observations sur les glaciers, et je compte que votre sentiment de justice vous engagera à les attendre plutôt que d'accepter quelque fausse monnaie. Je vous prie cependant de ne pas faire imprimer ceci parce que je compte faire moi-même la leçon à Mr. Forbes.

Je serais moins surpris de ce que vient de faire Forbes, si lorsque nous étions ensemble et que je le priais de contribuer à faire connaître avec moi les glaciers en prêtant à cette question l'appui du nom d'un physicien justement estimé dans le monde savant, il s'y était continuellement refusé, en répétant qu'il n'avait aucune opinion sur ce sujet, qu'il avait voulu seulement apprendre à les connaître en venant les étudier avec moi et qu'il se garderait bien de rien publier sur une matière dans laquelle il lui restait plus que des doutes J'étais bien loin de présumer que sous cette réserve se cachait l'intention de s'approprier les observations les plus précieuses de cette campagne.

Mr. Forbes a soin de dire que c'est dans ma société et celle de Mr. Heath de Cambridge qu'il a séjourné trois semaines sur le glacier. Pour être vrai il aurait dû dire que j'avais fait établir là haut un appareil de forage desservi par cinq ou six hommes y compris un maître foreur, que je m'étais fait accompagner d'un peintre qui a dessiné pour moi tous les accidents du glacier dont quelques uns ont été copiés par Mr. Forbes; que deux de mes amis, M. le Docteur Vogt m'aidait dans les recherches microscopiques et M. Desor dans celles concernant la géologie; c'était tout un établissement que Mr. Forbes s'appropie gratuitement par un prétentieux *our*. Qu'en serait-il si de leur côté les autres savants MM. Studer, Escher, Martins, etc., qui sont venus nous visiter et passer quelques jours avec nous, en faisaient autant?

Agassiz took the side of his secretary, and published, on the 21st of April, 1842, a pamphlet of ten octavo pages, without title, but which may be called, "A reply to Mr. James D. Forbes on the laminated structure of glaciers." The paper, although "privately distributed," was circulated largely among Agassiz's friends to the number of five hundred copies. It began with a reprint of a letter to M. Desor, under the date of 11th March, 1842, published by Forbes, with the remark: "The following letter from Professor Forbes to M. Desor of Neuchâtel was written in answer to one from the latter to the former, in which Professor Forbes is charged with having, in a paper on the structure of the ice of glaciers . . . assumed as his own a discovery previously well known to M. Agassiz and his friends. It appears that this injurious assertion has been pretty extensively circulated through private channels, and, in consequence, Professor Forbes has been advised by his friends to make his denial equally known." The assertion that Desor's written letter "has been pretty extensively circulated through private channels" involved a gratuitous supposition without foundation; the letter was not printed, and neither Agassiz nor Desor had even kept a copy of it. Forbes's printed letter, on the contrary, was largely circulated, although no copy was addressed to Agassiz; and Agassiz was obliged to make use of the "Private copy for Mr. Guyot" in order to have it reprinted in his pamphlet. If the "confidential adviser" of Agassiz, as Forbes calls Desor, erred in writing to Forbes in a rather surly tone, Forbes's letter is much more objectionable. In it

he calls to his help Studer, who was always only too ready to join in a crusade against intruders on his geological preserve of the Bernese Oberland. Forbes seems rather anxious not to appear to have studied "in the school of Agassiz"; but to show that the fact of the structure of the ice described in his notice was unknown to Agassiz, de Charpentier, and other writers. His remarks about "studying in a school" are childish in the extreme, and his knowledge of other works on the structure of the ice was certainly limited; for Hugi, Rendu, and before them David Brewster of Edinburgh, had observed the veined structure.

Agassiz's answer, dated the 29th of March, 1842, gives the whole story of the relations between him and Forbes. There is no doubt that Agassiz and every one who met Forbes under the auspices of Agassiz, both at the "Hôtel des Neuchâtelois" and at Neuchâtel, did everything possible to help Forbes, and were extremely kind and courteous to him; while, on his part, Forbes was austere to an extent seldom seen, even among Englishmen. The impression he made when in Switzerland was decidedly unfavourable, except in the case of a single person, Professor Bernard Studer, to whom he afterward dedicated his book, "Travels through the Alps of Savoy," etc., 1843. It was wrong on his part to accept the hospitality of Agassiz, and then to act as if he had met him in a hotel. He was constantly on his guard not to show any mark of assent, or to say anything which might be useful for future observations. His great reserve puzzled everybody; and when he left, there was a general feeling of relief. Through-

out his stay the relations were never cordial. He personified the celebrated type of Englishmen so well described and caricatured by Töpffer, in his "Nouvelles Genevoises," "Les deux-Scheidegg": "Je défendé vos de paaler à moa, quand je disé rien à vos." A true no! no![1] tall, thin, dry, haughty, and extremely egotistical.

Agassiz put forward the doubtful claim of Arnold Guyot to priority in the discovery of ribboned structure, noted by Hugi as far back as 1830. It would have been better had no attention been paid to Forbes's paper, which was written in bad taste and against all the rules of courtesy between savants.

The only person who obtained any benefit from this uncalled-for dispute was Desor, whose name, until then entirely unknown in England and on the continent, except in Switzerland, became conspicuous as the "confidential adviser" of Agassiz.

All friendly relations between Agassiz and Forbes ended with the following letter addressed by Agassiz to Forbes, then in a hotel at Neuchâtel:—

Le 12 Juin, 1842.

Monsieur,—Je viens de recevoir la brochure que vous m'avez fait l'honneur de m'adresser et pour laquelle je vous prie d'agréer mes remerciements. Je regrette que vous n'ayez pas encore reçu le récit de notre course à la Jungfrau que M. Desor vous a adressé il y a plusieurs mois, si j'en avais encore un exemplaire à ma disposition je vous l'adresserais, afin que vous puissiez en prendre connoissance.

[1] Rudolph Töpffer in his novel "Le Col d'Anterne" gives, as a type of a well-bred Englishman, a tourist set in front of the Mont-Blanc, who disclaimed to answer any of the numerous and polite questions asked by Töpffer, except by the two words, No! no! and Ui! ui!

A. AGASSIZ
1840
F. Merian
E. DESOR
HOTEL
des
Neuchatelois
A. FAVRE
J. F. Pictet
BRAVAIS
F. Keller
Wild
H. Hopkins
H. Goodwin
Dollfus
H. Weber
D. Dollfus fils
C. Vogt
C. Nicolet
B. STUDER
A. ESCHER
A. Guyot
Nicholson
H. Coulon
C. E. GIRARD
J. D. Forbes
Guides
Schimper
Müller
C. Martins
KURTZ

N'ayant reçu aucune réponse aux deux dernières lettres que j'ai eu l'honneur de vous adresser et après la réponse que vous avez faite à ma précédente, en livrant au public des remarques qui n'allaient qu'à votre adresse, je ne conçois pas quelle espèce de relations personnelles vous pouvez rechercher avec moi. Celles que j'aurais pu désirer, vous les avez rendues impossibles; et je ne saurais accepter les froides civilités d'une personne en qui j'avais vu un ami. Cela ne m'empêchera pas de rendre pleine et entière justice à celles de vos publications qui tiennent de loin ou de près aux recherches scientifiques que je poursuis.

Agréez, Monsieur, etc.,

Louis Agassiz.

It would have been wiser on the part of Agassiz and more profitable if, after his ascent of the Jungfrau and his two "séjours" at the "Hôtel des Neuchâtelois" in 1840 and 1841, he had let the glacial question take care of itself. The impulse he had given was quite sufficient to assure his reputation as one of the first and most successful workers; and his place, after Venetz and de Charpentier, was recognized as undisputed by all those who had studied glaciers and the glacial age.

Frightened at the constant increase of expenses, his Swiss and German families made remonstrances, and were absolutely opposed to a new establishment at the glacier of the Aar, to replace the "Hôtel des Neuchâtelois," which had gone to pieces during the winter, according to a report just received from the Grimsel. Agassiz's best scientific friends, with Humboldt at their head, hinted that, after all, his works on fishes furnished his best claim to reputation and celebrity. In a previous letter, dated Berlin, 17th of June, 1838, Humboldt, in a friendly way, had told him that he had never had

a secretary, or even a copyist, preferring to do all his writing, and expressing his fear when he learned that he had nine assistants in his employ, adding humorously, "I am sure that there must be some gold somewhere in your polished rocks. I should like to know your secret how to work so profitably and so quickly all these mines." Humboldt repeated his friendly advice during the summer of 1842, saying plainly that he, the man of the equinoctial region, was frightened by the *Eiszeit* and the terrible ice cap. But all this was in vain. Agassiz had an answer for every objection; and all that even his alarmed mother could obtain was a promise that he would not make any more ascents of inaccessible peaks, and be lowered again into hell, — "descente aux enfers," as his descent into the glacier well was familiarly called.

Arrived at the Grimsel, the 7th of July, 1842, Agassiz, with his numerous assistants, at once began observations and excursions, first to the Siedelhorn, and after that to the glacier of the Rhone. The troglodytic habitation under the immense block, having become unsafe, it was replaced by a long tent, divided into three compartments, used as laboratory and dining-room, sleeping-room, and dormitory for the workmen. The form of the tent — twenty metres long, four metres broad, and five metres high — recalled a Noah's ark, and was therefore christened "the Ark," [1] to distinguish it from the "Hôtel des Neuchâtelois," which was now used as a kitchen. The old cabin of the guides served as a stable

[1] The old name of "Hôtel des Neuchâtelois," however, continued in use; and the archaic word "Ark" was dropped before the summer was over.

for ten goats; and the establishment, as a whole, was a great improvement on the old one. Besides being built on the solid ground and not on the moving median moraine, it afforded a shelter, beneath which they could work whenever the rain obliged them to keep in doors. On the 10th of July it was ready for occupancy; and the same night Agassiz, Wild, Vogt, Nicolet, Desor, Burkhardt, and Girard slept under the canvas-covered cabin. A new member was added to the usual staff of Agassiz, — M. Wild of Zürich, who had been engaged by Agassiz as a topographical engineer, to survey and make a trigonometric plan of the Aar glacier. To be sure, the king of Prussia, on the recommendation of Humboldt, had granted nearly a thousand dollars for the continuance of Agassiz's glacial work; but this royal gift was soon expended, and before the campaign of 1842 was over, Agassiz was more deeply in debt than ever; for with him a gift, however large and important, was only an occasion to expend twice and three times more than he had received.

The stay at the glacier extended from the beginning of July until the middle of September, with numerous excursions, one as far as Altorf to attend the meeting of the Helvetic Society of Natural Sciences. Escher de la Linth and Ferdinand Keller (the same who twelve years after made the first discovery of the lacustrine habitation of prehistoric man) were among the guests who helped to make observations and experiments on the glacier. Numerous other guests came, but only as visitors and spectators. Investigations were made in regard to infiltration, lamellar structure, strati-

fication of the glacier, the purity and composition of the ice, the "crevasses," the temperature, the motion of the glacier, the ablation, and the *névé*. Agassiz had resolved to embody in a large publication, in three parts, everything relating to the glacial system. The first part, the only one ever published, was entitled "Nouvelles études et expériences sur les glaciers actuels, leur structure, leur progression, et leur action physique sur le sol," and was accompanied by a beautiful folio atlas, containing three maps and nine plates (Paris, 1847). The second part was to be on the "Alpine erratics," by Guyot. It was never written, only a few general conclusions being published, without maps of any sort. It is to be regretted, for Guyot had prepared a map showing the distribution of the Alpine boulders, which had not been published. However, a great part of it — more than two-thirds at least — was anticipated by the issue, in 1845, at Winterthur, of an anonymous map of the old glaciers of the Swiss Alps, showing the extent of the ancient glaciers of the Arve, Rhone, Aar, Reuss, Linth, and Rhine, with their lateral and frontal moraines. This map is entitled "Verbreitungsweise der Alpen-fündlinge," and its author is the modest and very able geologist, Arnold Escher von der Linth. Very likely the publication of this map discouraged Guyot, who was always extremely slow and timid; and he resolved to publish neither the volume advertised nor his map. As to the third and final part, by Desor, treating of erratic phenomena outside of Switzerland, it remained in the stage of contemplation, and was never begun.

Agassiz and all his collaborators and friends certainly worked hard and with a determination to penetrate all the secrets of the glaciers, and some of their observations and experiments are excellent and valuable; but it is no injustice to any of them to say that they were not sufficiently equipped and prepared for the work they had rather rashly undertaken. Devotion to progress of science was not sufficient; something more was required. De Charpentier and Bishop Rendu had already said all that could be expected from men not trained as physicists. Agassiz added very little, if any, to their work. What was wanted was a great physicist, to solve the problem of glaciers. James D. Forbes proved unequal to the task; and it was reserved for John Tyndall, the great pupil and successor of Faraday, as the discoverer of "radiant heat," to explain fully the origin of glaciers, the pressure theory, regelation, crystallization and internal liquefaction, the veined structure; in fact, all the mechanism of glaciers. The principles set forth in Tyndall's "The Glaciers of the Alps" (London, 1860), come next to the great discoveries of Venetz and de Charpentier, and to Agassiz's Ice-age. The four complete the survey of the subject.

In November, 1842, Agassiz, losing patience with the constant attacks in German newspapers directed against him by his formerly intimate friend, Dr. Karl Schimper, published a pamphlet entitled "Erwiederung auf Dr. Karl Schimper's Angriffe," four-page quarto, for private circulation, though it was freely distributed, more especially in Germany and Switzerland. It would have been better Agassiz had ignored these attacks; but

urged on, he says, by many friends, and I may add by the one called by Forbes "his confidential adviser," he wrote his "Reply to Dr. Karl Schimper's Attacks." In it, interesting details of their life as students, and of the sort of community existing at that time between Alexander Braun, the two Schimper brothers, and Agassiz are given, and the kindness and generosity of Agassiz to the two Schimpers are revealed; full justice is done to the brilliant intellect of Karl Schimper, and his share in the diagram entitled "Crust of the Earth as related to Zoölogy," constructed by him with the help of notes furnished by Agassiz, and afterward published (1848), is fully acknowledged. As to Agassiz's delay in returning specimens of fishes lent to him for his great work on fossil fishes, it was unavoidable, on account of the many specimens to be taken care of, and the delay in the publication. As soon as the work was finished, every specimen was carefully packed and returned in good condition.

Schimper's claim to a small collection of minerals offered to Agassiz at Carlsruhe, when Agassiz was on the point of beginning his lectures as professor at Neuchâtel, shows only too plainly how depressed and demoralized Schimper had become after the break in his relations with Agassiz in 1838.

The only fault, and it is a very trivial one, to be found with Agassiz, is that he did not refer to Schimper again in his volume "Études sur les Glaciers," in regard to the otherwise erroneous explanation of the diminution of the temperature of the globe with the disappearance of the animals, analogous to the phenomena accompany-

ing the death of individuals, and then of its rising again, due to the arrival of a new creation of animals, developing heat as a consequence. In his volume Agassiz reproduced Schimper's small mathematical figure, and it would have been well to quote Schimper as his authority. Alexander Braun, when consulted, threw the blame on Agassiz, but refused to take part in the dispute. In a letter from Agassiz to Braun, published in Braun's Life, by his daughter, he says that if he did not quote and speak of Schimper in his "Études sur les Glaciers," it was in order to punish Schimper for his unjustifiable conduct towards him; a very lame excuse, for scientific ideas and discoveries are sacred property, which cannot be cancelled under any circumstances. If Agassiz had repeated the sentence in his Neuchâtel Address of 1837, "l'explication de tous ces phénomènes (glaciaires) est le résultat de la combinaison de mes idées et de celles de M. Schimper," everything would have been satisfactory.

It is strange that Agassiz did not abandon the theories advanced in his "Discours de Neuchâtel," after its delivery; for they met with not the smallest acquiescence or encouragement, either from those who heard the address or from those who read it afterward. De Charpentier was against it, and Sedgwick, the celebrated geologist of Cambridge (England), expressed in happy terms the impression made on him by the reading of the "Études sur les Glaciers," when he said: "I have read his Ice-book. It is excellent, but in the last chapter he loses his balance, and runs away with the bit in his mouth."[1]

[1] "Life and Letters of Sedgwick," Vol. II., p. 18, Cambridge, 1890.

The immense "nappe" of ice covering the earth, its breaking by the upheaval of the Alps, etc., seem the theoretical views of a dreamer, and are entirely at variance with the excellent and remarkable observations on the power of glaciers to carry boulders, and their great extension during the Quaternary epoch. But it was a special characteristic of Agassiz's mind, which was intensified by the teaching of his great master Cuvier, seldom to acknowledge an error, but on the contrary to try by all means to maintain his position. He repeatedly made mistakes in dealing with other savants, and also in the too hasty generalizations which he sometimes put forward in natural history. I do not hesitate to attribute these weak points in Agassiz's character to the influence of the author of the "Anatomie Comparée," an influence which, if profitable on many accounts, was sometimes much to be regretted. At all events, Cuvier's influence was profound, and among many things that Agassiz learned in his laboratory, was one of his most pronounced faults, the authoritative and tyrannical attitude of the master, unable to accept a contradiction, or to abandon an idea, when once promulgated and in print.

The polemic with Karl Schimper was unfortunate, because Schimper was no longer responsible. Like all persons suffering from mental disorder, he thought he had discovered all that he had heard in regard to the glaciers and the glacial question during his long visits at Bex and at Neuchâtel, and he treated very slightingly Venetz, Charpentier, and Agassiz; he attributed to himself the lion's share, when he was only a poetical echo,

and a rather fantastic one at that, of what he had heard during his stay in Switzerland. His half-scientific, half-humorous poem "Die Eiszeit," printed at Neuchâtel, for friends, the 15th of February, 1837, the birthday of *Galileo Galilei*, whose name Schimper had assumed when a student, shows the state of mind into which he had already sunk; that of an obscured spirit. Schimper, after brilliant "débuts" in science, produced nothing but two small volumes of indifferent poetry, entitled "Gedichte" (Erlangen, 1840, and Mannheim, 1847); he published nothing on the morphology of plants, although he is justly regarded as one of its discoverers. Charged by Prince Maximilian of Bavaria, in 1842, to make a survey of the Bavarian Alps and the Palatinate, he made no report, and finally was confined in an asylum, at Schwetzingen, where he died the 21st of December, 1867.

There is no doubt that Schimper was a well gifted man. Without publishing a word, he left, as a botanist, a reputation of a high order, and he influenced both Alexander Braun and Agassiz to a great extent, possessing more imagination and original ideas than either of them. "Il n'a manqué à Schimper que d'être sobre," one of those who knew him best once said to me.

Among the visitors attracted by curiosity to the "Hôtel des Neuchâtelois," during the summer of 1842, was a great manufacturer of Mulhausen, M. Daniel Dollfus-Ausset. Such an enthusiast of high regions, of glaciers, and of the glacial question, has rarely existed. He was so fascinated by all that he saw on the glacier

of the Aar, that from that day he became not only an adept, but one of the most generous patrons of the work in progress on the Oberland glaciers. As a first step, he begged Agassiz to accept for him, and as many of his assistants as he wished, an invitation to pass the week between Christmas and New Year with him at the Hôtel des Trois-Rois at Bâle, as a relaxation from their hard work, and to celebrate his enrolment among the glacialists, and the inhabitants of the "Hôtel des Neuchâtelois." Agassiz, in company with Desor and Vogt, left Neuchâtel the 24th of December, 1842, and arrived at Bâle in time to celebrate "Le réveillon," or Christmas Eve. "Papa Dollfus," as he was always called afterward, received them most cordially, and for a whole week, with the exception of daily morning work at the Museum of Natural History, under the direction of the learned and very sociable Peter Merian, they were treated as princes of the sciences.

And thus Agassiz and his assistants ended the year 1842 at Bâle, in the enjoyment of a royal hospitality.

CHAPTER IX.

1843–1844.

"Recherches sur les Poissons Fossiles," 1833–1843 — Review of it by Jules Pictet de la Rive — Dr. A. Günther's Opinion — Agassiz's Errors with the Eocene Fossil Fishes of Glaris (Switzerland) — The Part taken by Collaborators in the "Poissons Fossiles" — Another Visit to the Glacier of the Aar — The Meeting of the Helvetic Society at Lausanne, July, 1843 — Agassiz's Hospitality at Neuchâtel — False Position of his Secretary, Desor, and his Assistant, Vogt — Scientific Life in Neuchâtel — "Monographies des Poissons Fossiles du Vieux Grès Rouge," 1844 — The Geologist and Stonecutter, Hugh Miller — "Histoire Naturelle des Poissons d'Eau douce" — Karl Vogt leaves Agassiz — Extraordinary Session of the Geological Society of France at Chambéry (Savoy) — Failure of Nicolet's Lithographic Establishment — Dinkel leaves Neuchâtel — Illness of Gressly.

The publication of the "Recherches sur les Poissons fossiles" continued through the ten years from 1833 to 1843, when the eighteenth and last part or "livraison" was issued, with "Additions à la préface," dated Neuchâtel, May, 1843, which may be considered as the last pages of that great work. It is a true monument to the science of palæontology, and to speak of it with authority requires such special study of ichthyology, that the only way to give an idea of its value is to quote one of the very few men able to speak of it with "con-

noissance de cause." For this reason, I have chosen to quote what Jules Pictet de la Rive says of it in his article, "Agassiz" ("Album de la Suisse Romane," 5ième vol., Geneva, 1847). Pictet had made a special study of fossil and living fishes, and his intimacy with and admiration for Agassiz never relaxed during his whole life. Independent by character and possessing a large fortune, Pictet's opinions are properly considered just and unbiassed.

"The 'Recherches sur les Poissons fossiles,'" says Pictet, "was one of the first conceptions of Agassiz, and form to-day his most substantial title to renown. It is in this beautiful work that the immanent qualities of our learned palæontologist shine more specially and that his rich imagination has full play, although always guided by a sagacious and well-balanced judgment based on conscientious researches and on a minute analysis of even the smallest parts of the organism.

"The limits of this article do not allow us to give a complete idea of the work, which is composed of five quarto volumes and a folio atlas of almost four hundred plates. We shall only try to set forth the aim, the plan, and the most important results.

"We know that when Cuvier published his first works on the fossils his principal aim was to demonstrate that the species destroyed by the revolutions of the globe and preserved as fossils are different from those living now on our continents and in our seas. That truth has to-day become unquestionable, and new discoveries have shown by the most undeniable evidence, that there have been in the history of the earth a series of epochs

during which the forms of the oceans and the continents have been successively modified, and each one of them has been characterized by a special flora and fauna; that is to say, by an ensemble of vegetables and animals specifically different from those coming before or after. The fishes have existed since the oldest ages of the globe, and their remains are found in all the successive periods. Their palæontological history, consequently, is most important, and furnishes precious data concerning this succession of faunas.

"When Agassiz began his researches and foresaw the importance of the result that he might draw from them, the classification of fishes was not advanced enough to allow sufficient comparisons. Some dissimilar forms were associated together, while other very similar ones were separated by large intervals. Before everything else, it was necessary to establish an exact classification. Agassiz found in the scales the necessary elements to solve the problem, and he recognized that these teguments of the body correspond well with the interior characters, and that their variations are, in general, associated with and due to, organic differences. He accordingly divided fishes into the following four orders: (1) The Cycloids, with scales, rounded, smooth, and simple at the margin, composed of laminæ of horn or bone, but without enamel, — endo-skeleton ossified; (2) the Ctenoids, with scales jagged or pectinated (like the teeth of a comb) on the posterior margin, formed by laminæ of horn, but without enamel, — endo-skeleton ossified; (3) the Ganoids, with angular scales regularly arranged like paving-stones, and composed of

horny plates covered with a strong, shining enamel, — endo-skeleton cartilaginous, in some partly osseous and partly cartilaginous; (4) the Placoids, with cartilaginous skeleton and skin covered irregularly with enamel plates, sometimes of considerable dimensions, at other times reduced to small points like the prickly, tooth-like tubercles on the skin of rays.

"This classification allowed easy comparisons and generalizations, and the palæontologic history of the fishes offered results not at all expected and most important. These animals have been completely renewed by successive creations, and whole populations of them have been destroyed to make room for others which were very different. Of the four orders indicated above, the Placoids, or cartilaginous fishes, have existed during all the geologic periods, though they have undergone various modifications, most remarkable especially in the teeth. But the other three orders — that is, the osseous fishes — have somehow replaced one another. Our present seas contain almost altogether Ctenoids and Cycloids, and, except two genera of Ganoids living in rivers of warm countries, these two orders compose all the present fauna of osseous fishes, while, on the contrary, none existed before the deposit of the chalk, and it would be vain to look in all the preceding epochs for one Ctenoid or one Cycloid; that is to say, the old seas did not contain a single fish with thin horny scales like our perches or our trout, while in the present fresh waters and seas we find such fishes almost altogether.

"On the other hand, the Ganoids were most common previous to the Cretaceous epoch, and that order, now

reduced, as I have said above, to only two genera, then formed the majority of the population of the seas. These same fishes present in their history a very remarkable fact. Until the Lias epoch, all the Ganoids possessed on the superior part of the tail a lobe formed by a prolongation of the vertebrate column. But from the Lias, on the contrary, all had a tail formed as that of the osseous fishes of the present time; that is to say, the vertebrate column stops at the base of the tail.

"It is, therefore, possible to divide the palæontological history of the fishes into three periods or epochs. During the first, extending from the Silurian to the Trias, the faunas are composed of Placoids and Ganoids with the vertebrate column prolonged to the upper lobe of the tail. In the second, which corresponds to the Jurassic epoch, we find the Placoids and Ganoids, with the ordinary tail. In the third, which began during the Cretaceous epoch and continued in our modern period, the Placoids, the Ctenoids, and the Cycloids form almost entirely the ichthyological population of the world. Hence, if a geologist found a Ganoid with a prolonged tail, he could conclude that the strata in which he found it belonged to the first period; a Ganoid with an ordinary tail would indicate, with sufficient certainty, that the group of strata belonged to the second epoch; and so on.

"It is easy to understand the interest created by a work, the aim and result of which are to demonstrate such remarkable laws, more especially when the proofs are based on an incredible number of facts and observa-

tions. The work of Agassiz mentions more than one thousand fossil fishes, with descriptions and beautiful plates, which make them known almost as well as if we were able to observe them alive.

"This work brought its author complimentary distinctions from several academies and learned societies. Particularly during a journey in England and Scotland all the collections were open to him, assistance in various ways was offered, and he had the great satisfaction of seeing with what astonishing precision the numerous new facts which he daily observed confirmed all his previous conclusions. The English and Scotch geologists for many years kept the remembrance of some keen anecdotes on the subject.

"Agassiz's researches opened a new path, through which he continued to advance, publishing in the meantime supplements to his main work; among them, a 'Monographie des Poissons du vieux grès rouge,' which was soon followed by one on the 'Poissons de l'Argile de Londres.' The first of these monographs furnished some interesting results, both geological and zoölogical; in particular, it demonstrated two most important laws: 1st, the analogy existing between the first condition of the embryos of fishes and the organization of fossil fishes of the oldest epochs; 2d, the parallelism existing between the embryologic development of the fishes and the succession of the different types of these animals in the series of formations."

There is nothing to add regarding the great value of this "vaste publication," as it is called by Pictet; but a few words are necessary to indicate some of the criti-

cism which it called forth, and to meet claims which have now and then been put forward.

Agassiz knew perfectly well that his classification was artificial, and not based on all the natural principles, as it should have been, and as Cuvier's was before him; but he wanted to make use of a great quantity of fragmentary specimens, and even mere scales of fishes, which were found in abundance, and which otherwise would have been useless, and would have left a great gap in his series of forms. He worked as much to prove the succession of fishes in the different systems of strata, as to obtain a knowledge of them zoölogically, trying to find laws which might be used in palæontology to classify groups of strata by their fossil fishes. And he succeeded admirably, notwithstanding the defect of his empiric classification.

As Dr. A. Günther says: "We have no hesitation in affirming that if Agassiz had had an opportunity of acquiring a more extensive and intimate knowledge of existing fishes before his energies were absorbed in the study of fossil remains, he would himself have recognized the artificial character of his classification. The distinctions between Cycloid and Ctenoid scales, between Placoid and Ganoid fishes, are vague, and can hardly be maintained. So far as the living and post-Cretacean forms are concerned, he abandoned the vantage-ground gained by Cuvier; and therefore his system could never supersede that of his predecessor, and finally shared the fate of every classification based on the modifications of one organ only. But Agassiz has the merit of having opened an immense new field of researches by his study

of the infinite variety of fossil forms. In his principal work, 'Recherches sur les Poissons fossiles,' 1833–1843 (4to, atlas folio), he placed them before the world, arranged in a methodical manner, with excellent descriptions and illustrations. His power of discernment and penetration in determining even the most fragmentary remains is truly astonishing; and if his order of Ganoids is an assemblage of forms very different from what is now understood by that term, he was, at any rate, the first who recognized that such an order of fishes existed."[1]

Agassiz was one of those naturalists who find it easier to discover differences than to bring together specimens of fossils. He possessed a rare power of discerning the smallest differences between allied forms of animals; but sometimes he went too far, as in the case of the Eocene fossil fishes in the flysch of Glaris (Switzerland), where the cleavage resulting from the breaking and compressing of the strata, during the dislocation of the Alps, deformed some specimens to such an extent that Agassiz was led to establish six species of *Anenchelum*, all of which really belong to a single species, *Lepidopus glaronensis*. The same mistake has been noted by Dr. A. Wettstein and A. Heim for species of the genus *Palæorhynchum*, *Acanus*, etc. ("Actes de la Société Helvétique des Sciences naturelles," Geneva, August, 1886, pp. 46, 47). India-rubber models of some of these fossil fishes, when pulled in certain directions, give as many species as Agassiz founded; and it is evident that Agassiz, in some cases, too easily multiplied

[1] "Ichthyology," by A. Günther, in "Encyclopedia Britannica," ninth edition, Vol. XII., p. 634, London, 1881.

the number of species without proper restriction. But this is only a detail, which does not affect the final result and conclusions, nor the prodigious capacity of his memory, in which lay the true secret of his classification of fossil fishes.

In regard to the help that Agassiz received in his "Poissons fossiles": in the first place, the excellent drawings were made by Dinkel and Mrs. Agassiz, those of the latter being fully as good as and rivaling in execution the best of the artist Dinkel. Secondly, after the issue of the first twelve parts or "livraisons," Agassiz made a great deal of use of his assistant Karl Vogt and his secretary Desor, in preparing the bones and the scales, and in writing the descriptions of species and even of genera. But as Vogt wrote me: "Agassiz avait parfaitement le droit de s'attribuer ces travaux, car il me payait pour cela, j'étais son préparateur à gages sous ce rapport." Only one-third of the work was thus prepared with his two collaborators, under Agassiz's direction; but this may be said, that it would have been much better if he himself had finished what he had so well begun and continued until 1838.

At the end of July, 1843, Agassiz returned to his work on the glacier of the Aar. A new cabin had been erected, which was called the "Pavillon"; and Daniel Dollfus-Ausset, with his son, established himself close by, in another cabin. The time was passed in measuring the motion of the glacier, its temperature, etc., and in Alpine climbing. On the whole, it was a rather expensive campaign, and the results were inadequate compared with the money expended.

During the meeting of the Helvetic Society of Natural Sciences at Lausanne, the 25th and 26th of July, Agassiz made a verbal communication in regard to his researches on the glaciers, speaking of the new and more practical direction given to his studies, and insisting on the stratification of the glaciers and the blue bands of ice, and on the formation of crevasses. At the same meeting, he spoke of the great value of fossil fishes in determining the ages of the "terrains," and more particularly of the squaloid teeth, like those of the true sharks, or squalodonts, the *Ptycholepis* of the Chalk, the *Strophodus* of the Jura, the *Acrodus* of the Lias, and the *Psammodus* of the Coal measures.

His great sociability, which attracted so many people to the "Hôtel des Neuchâtelois," was exercised on rather a large scale in Neuchâtel, if we may judge by the following letter: —

NEUCHÂTEL, 23 décembre, 1843.

PROFESSEUR JULES PICTET DE LA RIVE,
Genève.

Mon cher ami, — Favre vous aura fait part du désir que j'ai de réunir ici quelques amis Jeudi prochain. Je viens insister auprès de vous pour que vous soyez de la partie.

En arrivant Mercredi soir et en descendant "Aux Alpes," vous trouverez Mérian, Escher, Studer et Valentin.

L'un de mes guides m'a procuré un jeune chamois dont nous dépécerons les os Jeudi chez moi. Faites-moi le plaisir de venir; si vous pouvez, amenez les Plantamour.

Votre tout dévoué,

LS. AGASSIZ.

His prodigious power of attraction is shown in his ability to bring together, for a single dinner party, at

Christmas time, during the snowy season, savants from every part of Switzerland, from Bâle, Zürich, Berne, Geneva, etc., and at a time when travelling was not easy, as it is now, with railroads in every direction. Nothing shows better that Agassiz was an accepted leader among the scientific men of Switzerland.

The year 1844 was a sad year with Agassiz. We must turn back a few years in order to understand the state of affairs, and how, little by little, he jeoparded his position by a complete incapacity to manage his assistants, his many employees, and his too numerous undertakings. Too great familiarity with his assistants, and inability to keep them at respectful distance, resulted in his having no authority over them. If Agassiz was a genius in natural history, in private life he was entirely unable to manage his immediate surroundings. Speaking of Agassiz's establishment at Neuchâtel, Karl Vogt says: "It was a scientific factory with a community of property; only, unhappily, neither the number of workmen nor the capital engaged was sufficient and in proportion to the production." It was also an overworked establishment. Agassiz, as its director, had to provide everything; first the money, for all were penniless; and the life they led, though without luxury, was, after all, rather expensive; for to travel all over Switzerland, to stay at the "Hôtel des Neuchâtelois," to keep open house at Neuchâtel not only for his assistants, but also for all the naturalists who were continually coming from every part of Europe, required a constant expenditure of no small amount of money. Besides the work of providing the money, Agassiz had an oversight

of every work going on; he had to dictate letters, to insert sentences in the descriptions of his assistants in order to connect them and give them unity, to read and correct at least one of the proofs; even to direct the draughtsmen, and to select the drawings to be used, in regard to the artistic merits of which he was very critical and a capital judge, seeing faults where others were glad to admire the fine execution. Agassiz was well seconded by the artists in his service; but scientifically the assistance he received was rather deficient. Karl Vogt had been educated as a naturalist, and soon became most efficient in regard to the anatomy and the embryology of fishes; he also worked out the osteology and neurology, prepared the specimens, made the drawings, and wrote the descriptions. He was a first-rate assistant, knowing well his duties; and during the five years of his connection with Agassiz he did a great amount of good work. Although he always insisted that he was not a pupil of Agassiz, having learned zoölogy in Germany, there is no doubt of the great influence exerted by Agassiz on his work during the first ten years of his life as a naturalist.

In October, 1837, as we have seen, Agassiz engaged Desor as his private secretary, who, until then had done nothing in natural history, with which he was not even acquainted, beyond the general knowledge possessed by any student of a university. Employed first as a translator and a writer of dictated letters, he soon acquired sufficient knowledge of fossil fishes and fossil echinoderms, to help in describing species. Under Agassiz's teaching he made such rapid progress that,

in three years, he became a useful assistant, not only in palæontological works, but also in the work on the glaciers and the glacial question. Vogt says of him, that in 1840 Desor was the "cheville ouvrière" (key-stone) of the whole Agassiz establishment; and Agassiz, on the 11th of June, 1840, writes: —

> Dans la rédaction de cette seconde partie (Cidarides) de mon mémoire ("Description des Echinodermes fossiles de la Suisse") j'ai été continuellement assisté par M. Desor, qui a continué à me prêter l'appui de sa plume facile, comme il l'avait déjà fait pour la première partie. Mais cette fois son travail ne s'est pas borné à une simple rédaction; l'examen comparatif des nombreuses espèces des genres Diadème et Cidaris, dont les caractères sont si difficiles à apprécier, est même entièrement de son fait. Cependant j'en ai revu la description, afin d'en partager avec lui la responsabilité scientifique. Il m'est précieux d'avoir trouvé dans un ami un collaborateur aussi distingué.

Desor had no initiative faculty, and was totally devoid of original ideas. He never rose above a third-rate naturalist, retaining all his life the spirit of a lawyer, with a special tendency to politics and a politician's methods. Charles Girard was in too modest a position to be helpful scientifically, except in the work of compilation, which he always performed very industriously. As regards Gressly, the help he gave Agassiz was invaluable; the exact geological position of two-thirds of the fossils described in the different palæontological works of Agassiz was learned from him; and he furnished more than half of the best specimens of the echinoderms, the Myas and the Trigonias. In the scientific association directed by Agassiz, Gressly acted as the St. Bernard dog, faithful, true, living, no one knew exactly how, on

the crumbs from the table always spread in Agassiz's home; always satisfied, always respectful, and never so happy as when Agassiz expressed his admiration of the beautiful and rare fossils he drew from his numerous and large pockets on his return from his never-ending explorations in the Jura. However, an assistant as modest and inexpensive as Gressly is a rare exception, and Agassiz never again found one like him.

It was evident that something was wrong in the whole establishment, and that running on such a basis it would not last long. In fact, 1844 was its last year, as we shall see further on. But before relating the numerous incidents which one by one occurred and finally destroyed, at least partially, that extraordinary and brilliant scientific centre, due entirely to the genius of Agassiz, it is pleasing to call attention to two of the best works done at Neuchâtel under the impulse of this remarkable man.

One of his most important works, and certainly his most original, is the "Monographie des Poissons fossiles du Vieux Grès rouge ou Système Dévonien [Old Red Sandstone] des îles Britanniques et de Russie" (4to, with a folio atlas of forty-one plates), which was issued by "livraisons," or parts, the last three being distributed in August, 1844. The material used was mainly the specimens collected at Cromarty, in the North of Scotland, by the celebrated geologist and stonecutter Hugh Miller.

During the ten years previous to Agassiz's visit at Cromarty, in September, 1840, Miller, with great patience and skill, had unearthed from the old red

sandstone the most wonderful forms of animals yet found. Agassiz says of some of them: "It is impossible to see aught more bizarre in all creation than the *Pterichthyan* genus: the same astonishment that Cuvier felt in examining the *Plesiosaurus*, I myself experienced, when Mr. H. Miller, the first discoverer of these fossils, showed me the specimens which he had detected in the Old Red Sandstone of Cromarty." As early as 1831, Miller found the *Pterichthys*, or winged fish; but Agassiz did not hear of it until 1838, when a description and drawing was shown him in Paris by an English naturalist: he was greatly interested in this new form of life, and very anxious to see more of it. The following extract from Hugh Miller's principal and most popular work, "The Old Red Sandstone," explains how Agassiz was first made acquainted with Miller's wonderful discoveries: —

> A letter which I wrote early in 1838 to Dr. Malcolmson, then at Paris, and which contained a rude drawing of the *Pterichthys*, was submitted to Agassiz, and the curiosity of the naturalist was excited. He examined the figure, rather, however, with interest than surprise, and read the accompanying description, not in the least inclined to scepticism by the singularity of its details. He had looked on too many wonders of a similar cast to believe that he had exhausted them, or to evince any astonishment that geology should be found to contain one wonder more ("The Old Red Sandstone" by Hugh Miller, p. 119, Boston, 1854).

Although Agassiz had great sympathy and very cordial relations with Hugh Miller, their correspondence was extremely limited. Mrs. Agassiz says that with a single exception no letters have been found from him among Agassiz's papers; and she gives that unique

letter in Vol. II., pp. 470–477 of her work ("Louis Agassiz, His Life and Correspondence"). Lately another letter has been found in Switzerland by M. Auguste Mayor, and I here give an extract from it. The principal part is descriptive of specimens of fossil fishes sent to Agassiz, which would be unintelligible without good figures, and is consequently omitted; but the parts given are interesting on account of the great originality and keenness of the writer.

CROMARTY, 30th May, 1838.

PROFESSOR AGASSIZ,
Neuchâtel.

Honored sir. — I have just learned from my friend Dr. Malcolmson that you have expressed a wish to see one of the fossils of my little collection. I herewith send it you and a few others which you may perhaps take some interest in examining.

I fain wish I could describe well enough to give you correct ideas of the locality in which they occur. Imagine a lofty promontory somewhat resembling a huge spear thrust horizontally into the sea, — an immense mass of granitic gneiss, forming the head and a long rectilinear line of Old Red Sandstone the shaft. On the south side are the waters of the Moray Firth, on the north those of the Firth of Cromarty. The claystone beds which contain the fossils occupy an upper place on the sandstone shaft, covering it saddlewise from firth to firth. A bed of yellowish stone about sixty feet in thickness lies over them, except where they are laid bare by the sea, or cut into by two deep ravines — a bed of redder stone of unascertainable depth (though it may be measured downwards for considerably more than one hundred yards) lies beneath. The beds themselves average from ten to thirty feet in thickness. They abound everywhere in obscure vegetable impressions and fossil fishes, but in some little spots these last are much better preserved than in the general mass. All my more delicately marked fossils have been furnished by one little piece of beach hardly more than forty square yards in extent.

Of all the fossils of these beds, the one with the tuberculated covering seems least akin to anything that exists at present. I have split up many hundred nodules containing remains of this animal, for in the time of the Old Red Sandstone it must have existed by myriads in this part of Scotland. The larger ones I have invariably found broken and imperfect. The nodules in which they occur are in general too small to contain more than detached parts of them when large; and besides, the coat of the creature, consisting of hard plates separated apparently by sutures, must have offered a very unequal degree of resistance to the superincumbent weight. And, however, though the plates themselves are often as well defined and entire as the bits of a dissected map, they are almost always found displaced and lying apart. It is only the smaller fossils that I find perfect enough to furnish me with anything like adequate ideas of the original shape of the animal: but in these, though the general outline be better preserved, the plates are comparatively obscure. Thus the bits of the dissected map still want a key, and I have not yet become skilful enough to place them together without one.

The form of the body of the creature seems to have somewhat resembled that of a tortoise. . . . Pardon me, honored Sir, that I use this minute in describing these differences to you who observe better than any one else and can make a better use of what you observe. I have not succeeded in convincing some of our northern geologists that we have two varieties of small scaled fish in our beds, and I am now appealing to you as our common judge, and thus showing the ground of my appeal. Besides, as I cannot send you my specimens by hundreds, I deem it best (though it may seem presumptuous in one so unskilled) to communicate in this way the result of my examinations of the whole. One single specimen sometimes furnishes a characteristic tract regarding which perhaps fifty illustrations of the same fossil may be silent. Among all my specimens of the fish with the spines, only one shows me that the animal was marked by a lateral line. . . . I am afraid, however, that when thus communicating the results of some of my petty observations, I am but gaining for myself the reputation of being a tedious fellow.

I need not say how heartily welcome you are to the specimens I send you, should you have any wish to retain them. . . . Do I ask too much, honored Sir, when I request a very few lines from you to say whether the formation in which these fossils occur be a freshwater one, or otherwise, and whether the small scaled fish with the teeth be of a kind already known to geologists or a new one? I am much alone in this remote corner — a kind of Robinson Crusoe in geology — and somewhat in danger of the savages who cannot be made to understand why, according to Job, a man should be "making leagues with the stones of the field." But I am sanguine enough to hope that the good nature, of which my friend Dr. Malcolmson speaks so warmly, may lead its owner to devote a few spare minutes to render these leagues useful to me.

I am, I trust, sufficiently acquainted with geology, rightly to value the decisions of its highest authority.

I am, honored Sir, with sincere respect,

Your most obedient Servant,

HUGH MILLER.

P.S. — Since writing the above, I have picked up a specimen which, I am pretty sure, you would deem interesting, but for which I have unluckily no room in the box. It contains parts of the tuberculated fossil, and among the rest the teeth of the creature. These last somewhat resemble the teeth of a lobster, being apparently cut out of the solid part of the jaw rather than fixed in it.

H. M.

Miller found more specimens, and more perfect ones, in newly discovered beds of Old Red of Nairnshire, and when Agassiz visited him in 1840, he showed him three well-preserved species of the *Pterichthys*, and the wings of a fourth. To one of these remarkable animals, looking like the letter T, Agassiz has given the appropriate name of *Pterichthys Milleri*. Complete and good specimens were exhibited at the Glasgow Meeting of 1840, and some restorations of the animals were made by

Dinkel, in 1844, for the "Medals of Creation" by Dr. G. Mantell, and were reproduced in the "Vestiges of Creation." But Dinkel, so well trained, and so long Agassiz's artist of fossil fishes, was not successful; and he failed also in trying the restoration of another rather curious form of Old Red fish, the *Coccosteus* or *berry-on-bone*. These two examples show what strange creatures existed during the Devonian period, and the credit of determining their place is due to Agassiz's keen eyes and great knowledge of comparative anatomy; for he did not hesitate, on receiving the first broken and very imperfect specimens, to say that the creatures must have been fishes. As Miller says: "I received new light from the researches of Agassiz which, while it did not show my way more clearly, rendered it at least more interesting by associating with it one of those wonderful truths, stranger than fiction, which rise ever and anon from the profounder depths of science, and whose use, in their connection with the human intellect, seems to be to stimulate the faculties. I have often had occasion to refer to the one-sided condition of tail characteristic of the ichthyolites of the Old Red Sandstone." "It characterizes," says Agassiz, "the fish of all the most ancient formations. At one certain point in the descending scale, Nature entirely alters her plan in the formation of the tail. All the ichthyolites above are fashioned after one particular type — all below after another and different type."[1]

In his preface to "The Old Red Sandstone," Agassiz says: "So true is it that observation alone is a

[1] "The Old Red Sandstone," pp. 115-116, Boston, 1854.

safe guide to the laws of development of organized beings, and that we must be on our guard against all those systems of transformation of species so lightly invented by the imagination." What a prophetic and true sentence against Darwin's "Origin of Species," published fifteen years after. Observations and facts only are given in his "Old Red Fishes," which he has well summarized in the following words: "What I wish to prove here, by a careful discussion of the facts reported in the following pages, is the truth of the law now so clearly demonstrated in the series of vertebrates, that the successive creations have undergone phases of development analogous to those of the embryo in its growth, and similar to the gradations shown by the present creation in the ascending series, which it presents as a whole. One may consider it as henceforth proved that the embryo of the fish during its development, the class of fishes as it at present exists in its numerous families, and the type of fishes in its planetary history, exhibit analogous phases through which one may follow the same creative thought like a guiding thread in the study of the connection between organized being. . . . The facts, taken as a whole, seem to me to show, not only that the fishes of the Old Red constitute an independent fauna, distinct from those of other deposits, but that they also present in their organization the most remarkable analogy with the first phases of embryologic development in the bony fishes of our epoch, and a no less marked parallelism with the lower degrees of certain types of the class as it now exists on the surface of the earth."

The "Monograph of the Fossil Fishes of the Old Red" is more important for the embryologic development, the zoölogical gradation, the geological succession, and the geographical distribution in the past and the present, than the "Origin of Species," by Darwin. It has remained, and will continue to remain, a landmark in zoölogical researches, because nothing in it is left to supposition. Instead of being a work of the imagination, a philosophical dissertation, like the "Origin of Species," it is simply a record of facts and very keen observations; and in science, and more especially in natural history, nothing is of value except exact observations. Agassiz was not an opponent of development; on the contrary, he gave facts in its favour, many years before Darwin did; but he was averse to drawing too hasty conclusions; and he leaned all the time "upon an intellectual coherence, and not upon a material connection"; and he thought that variability seemed controlled by something more than the mechanism of self-adjusting forces. In a word, Agassiz, after his student life, was not a materialist, but a spiritualist, in natural history, an adversary, both of agnosticism and of pietism; for he says: "I dread quite as much the exaggeration of religious fanaticism, borrowing fragments from science, imperfectly, or not at all, understood, and then making use of them to prescribe to scientific men what they are allowed to see or to find in nature" (Louis Agassiz, in a letter to Professor Adam Sedgwick, dated June, 1845 [1]).

[1] "Louis Agassiz," by Mrs. E. C. Agassiz, Vol. I., p. 388.

The "Histoire naturelle des Poissons d'Eau douce de l'Europe Centrale" remained unfinished, and has a rather curious history. Agassiz began it as far back as 1828, when he was a student at Munich, and when his artist friend, Joseph Dinkel, was already making drawings of freshwater fishes for him.

In 1839 appeared the first "livraison" of a folio atlas, published "aux frais de l'auteur," and dedicated to the British Association for the Advancement of Science. This first monograph treated of the salmon family, and was divided into two parts: the first, containing the twenty-seven well-executed and luxuriously printed plates by Dinkel, Sonrel, and Nicolet, illustrating the genera *Salmo* and *Thymalus*, with explanations in French, German, and English, and with a cover designed by Dinkel, representing fishes in all sorts of attitudes and groups, with a boy four years old — the portrait of Alexander Agassiz — fishing on the shore of the Lake of Neuchâtel. The second part of the plates was announced to be issued with the first volume of text; but changes were made, and the text of Vol. I., containing the "Embryologie des Salmones," by C. Vogt, was published in 1842, without plates, the latter being issued in 1848, in Vol. III. of the "Mémoires des Sciences naturelles de Neuchâtel."

Agassiz, under the date of 1845, in the introduction of the "Anatomie des Salmones," by L. Agassiz and C. Vogt, gives the following explanation: "The anatomical studies contained in this memoir were undertaken for the 'Histoire naturelle des Poissons d'Eau douce de l'Europe Centrale, de M. Agassiz,' and were

at first destined to form the second volume. Some special circumstances have led the editor to adopt another mode of publication.

"In order to render justice to every one, it is desirable to remark here that the *Osteology* and the *Neurology* are due to the researches of M. Agassiz, while the *Myology*, the *Splanctionology*, the description of the 'sensitive organs' and the *Angiology* have been worked out by M. Vogt. All the plates were drawn by M. Vogt. This work dates as far back as 1843 and 1844, a few observations being added in 1845.

"L. A."

That Agassiz directed the work and freely gave his advice to Vogt, there is no doubt; but in some way Vogt became dissatisfied. He disapproved of the organization and methods of Agassiz's establishment, and was more or less disappointed in his expectations; and, in consequence, in the autumn of 1844, after acting as Agassiz's assistant for five years — during which time he certainly worked most efficiently and very hard — he left him to try his fortune in Paris. Strange to say, the break between Agassiz and Vogt, instead of healing as the years went by, increased to such an extent, that they were very unjust and bitter towards one another. It must be regretted, for nothing really important and seriously affecting either had occurred between them. Agassiz never published anything against Vogt, though Vogt might have shown more discretion in his printed criticism; and I do not hesitate to say that he was unjust and guilty of exaggeration

touching some points, and that all that he says about Agassiz's life in America is absolutely erroneous. He disliked Neuchâtel and the Neuchâtelois, and most of his indignation was hurled against them through and to the detriment of Agassiz.

Although Agassiz spent a few days in 1843 on the Aar glacier, his interest in the work going on there was manifestly lessening, and in 1844 he failed to make his usual summer visit.

In July, 1844, Desor, with the permission of Agassiz, published a very interesting and well written volume, entitled, "Excursions et Séjours dans les Glaciers et les hautes Régions des Alpes, de M. Agassiz et de ses Compagnons de Voyage" (Neuchâtel, 12mo). The volume begins with an excellent "Notice sur les Glaciers," by Agassiz, a masterly paper, which gives a scientific turn to the whole work; the rest is written in a picturesque style, and in imitation of the celebrated and popular works of Rudolph Töpffer, the artistic and "spirituel" author of the "Nouvelles Genevoises" and the "Voyages en zig-zag."

It was certainly very generous in Agassiz to allow his secretary to publish at this time all his researches on the glaciers and among the Alps; for it affected the sale of his own "Études sur les Glaciers" (1840) and "Nouvelles Études sur les glaciers actuels" (1847). The last one, more especially, found no sale at all, everything in it having been anticipated by Desor's publication, which, though not so fully developed, rendered Agassiz's work almost superfluous. Desor had taken the lead in the glacial question, and was strug-

gling with its physical problems, for which he was quite as little prepared as Agassiz. Every impartial observer saw this plainly; and it was melancholy to see Agassiz's already straitened resources expended upon almost useless works.

Although the extraordinary meeting of the Geological Society of France, in the Swiss Jura, at Porrentruy, Soleure, and Bienne, in 1838, had much advanced the recognition of the glacial question, it was important that another meeting should be held, this time in the very centre of the phenomena, among the Alps. The city of Chambery, then belonging to the kingdom of Piedmont and Sardinia, was chosen, and the society held its extraordinary session there, during the month of August, 1844. Agassiz presided over several of the meetings; as did also Bishop Rendu. Here these two great masters of the glacial theory met and entirely agreed. After a full and very clear exposition by Bishop Rendu of his "Théorie sur les Glaciers en Général,"[1] the 15th of August, Agassiz says that he agreed "entirely with the theory as it was explained by Bishop Rendu." Numerous adversaries, representing the theories of mud currents, or also of icebergs, tried hard to oppose them; but one after another was silenced by the numerous facts brought forward by Agassiz, Rendu, and others. It was the last strong attempt to resist the glacial theory. Afterward, Élie de Beaumont and his numerous adherents in France and Italy, as well as Leopold von Buch, continued their opposition, in a sort of Platonic

[1] "Bulletin Société géologique de France," 2ième série, Vol. I., pp. 631–636, Paris, 1844.

way, to cover their retreat. But we may truly say that the Chambery session of the Geological Society of France was the Waterloo of the mud theory for transportation of boulders.

Agassiz, as usual with him, was very brilliant in his exposition of all the observations he had made on the glacier of the Aar; and Bishop Rendu admirably described the phenomena in Savoy. Agassiz, more especially, insisted that proofs accumulated every year to show that the "Ice-age" extended all over Europe, and that the Alps were formerly a great central mass of ice, extending forty leagues all around, as far as Lyons. Professor Angelo Sismonda, of Turin, continued to maintain that the phenomena did not extend to the southern part of the Alps of Piedmont, until Professor Bartholomeo Gastaldi finally proved beyond question, in 1850, that ancient glaciers occupied the whole valley of the Pô and other valleys in Piedmont, just as they did the valleys of the Rhone, the Arve and the Isère rivers. I well remember those discussions, for I was a hearer of several of them, and can vouch for the splendid part taken by Agassiz in hastening the acceptance of the glacial doctrine. We may say, without any exaggeration, that the interference of Agassiz advanced fully thirty years the recognition of the glacial theory, and that he, and he alone, established the great "Ice-age."

Signs of bad management were visible in more than one direction. The great lithographic institution of Hercule Nicolet was kept running with the greatest difficulty. After bringing about an association of Nicolet with a capitalist, M. Jeanjaquet, Agassiz was con-

stantly obliged to furnish work absolutely unnecessary and very expensive. In a letter to the firm Nicolet and Jeanjaquet, dated 2d July, 1842, Agassiz says: "Vous êtes parfaitement libres de faire ce qu'il vous plaira à l'égard de vos employés; déjà trop souvent j'ai fait faire des travaux considérables *uniquement* pour occuper vos employés, travaux qui me sont restés des mois et des mois inutilement sur les bras. J'ai fait tirer de fortes éditions d'ouvrages divers, dont je n'ai que peu d'exemplaires placés, pour vous accommoder. . . . J'ai l'honneur de vous prévenir que je désire savoir si je puis compter sur les travaux dont je vous ai parlé lors de ma dernière visite aux Sablons, parce que sans cela j'ai réellement l'intention de les faire faire ailleurs, car je suis sûr d'avance qu'ils me coûteront beaucoup moins." We have here Agassiz's own confession that he undertook some works, solely to give occupation to the too expensive lithographic establishments of the Sablons, — an unbusiness-like proceeding, which was certain to hasten the catastrophe which occurred, in February, 1845, after a struggle of more than a year and a half, when the whole establishment was broken up and disposed of by auction.

Joseph Dinkel, the trusted and true friend of Agassiz, his constant companion since they were students together at Munich, left him to go to England to find work and make a home for himself. He disapproved the leadership of Desor, and foresaw very stormy times for his good friend Agassiz; and he prophesied to an artist friend, who repeated it to me a few years after, that Agassiz would not always submit to such a dictatorship

as Desor had assumed, and that it would end in terrible strife. Dinkel clearly saw the game Desor was playing. From the first he did not like him, and it was very painful to him to see Agassiz fall into such hands. He left Neuchâtel, with regret, in the spring of 1844, and many years after acknowledged "that for a long time he felt unhappy at the separation." In most graphic terms he described Agassiz, who, he says, "was a kind, noble-hearted friend; he was very benevolent, and if he had possessed millions of money, he would have spent them upon his researches in science, and have done good to his fellow-creatures as much as possible."[1] Every word is true, and is a noble tribute from one who knew Agassiz most intimately during the time of life when faults of character are most conspicuous, and are easily discovered in the intimacy of friendship.

Still another misfortune befell Agassiz at the close of the year 1844. Gressly, who usually returned to the laboratory in Neuchâtel at the beginning of the winter, did not come back; and it was only after weeks had passed without any tidings of him, that it was learned that the poor fellow was suffering under an attack of religious insanity, and had been placed in an asylum.

[1] "Louis Agassiz," by Mrs. E. C. Agassiz, Vol. I., p. 142.

CHAPTER X.

1845.

"Monographie des Myes," 1842–1845 — The "Nomenclator Zoologicus," 1842–1845 — "Bibliographia Zoologiæ et Geologiæ" — "Iconographie des Coquilles tertiaires réputées Identiques avec les Espèces Vivantes," etc. — The Two Translations of Sowerby's "Mineral Conchology of Great Britain" — Actual Mercantile Value of Agassiz's Publications — Agassiz's Family come to his Help — Great Credit Due to Neuchâtel and its Inhabitants — Agassiz's Last Series of Lectures: "Notice sur la Géographie des Animaux" — Intimate Friendship with Jules Pictet de la Rive — Agassiz's Last Visit to the Aar Glacier — The Meeting of the Helvetic Society of Natural Sciences at Geneva, August, 1845 — A Letter to Pictet, with Biographical Remarks — Biography of Agassiz by Pictet — Agassiz returns all the Specimens borrowed for his Great Palæontological Works.

The year 1845 was spent mainly in finishing the publication of works more or less advanced, and in making a sort of scientific "liquidation," or clearing up. The "Monographie des Myes," a quarto volume, with an atlas of ninety-four well-executed plates, begun in 1842, an excellent and very useful work, containing a number of new, well-defined genera, and which has since been used constantly in conchology, was completed. Alcide d'Orbigny criticised several of the new

genera, but Agassiz answered him successfully in his "Introduction," maintaining the value of such genera as *Goniomya*, *Ceromya*, *Arcomya*, *Mactromya*, *Pleuromya*, *Gresslya*, *Cardinia*, etc., and in a letter to Pictet, dated Aug. 15, 1845, he says: "Je crois que vous avez accordé un peu trop d'importance aux critiques que d'Orbigny a faites de quelques uns de mes genres des Myacées. Dans ma 4ième livraison j'ai réfuté ce qui me paraissait exagéré; il y a des remarques justes, mais il y en a quelques unes qui sont complètement erronées."

The manuscript of another work of great importance, of which the first part was issued in 1842, the "Nomenclator Zoologicus," was pushed forward with that strong will which was now and then characteristic of Agassiz. As he says, the work embraces the sources of critical zoölogy: "C'est un travail de patience qui a exigé des recherches bien longues et bien pénibles. J'en avais conçu le plan dès les premières années de mes études et dès lors je n'ai jamais perdu de vue ce projet. J'ose croire que ce sera une digue contre la confusion babylonique qui tend à envahir le domaine de la synonymie en Zoologie" (Letter to M. de Chambrier, President of the State Council of Neuchâtel, April, 1842).

The publication, which is in Latin, is a large quarto, issued in eleven fasciculi; the last one, which treats of the *Coleoptera*, having been published at Soloduri, in 1846; while the "Prefatio indicis universalis" is dated Neocomi, Mense, Decembri, 1845. The "Index" alone comprises 393 quarto pages; a duodecimo edition was

also issued at the same time. The general "Prefatio" at the beginning of the work was written entirely by Agassiz. It occupies forty-two pages, rendering justice to all his collaborators, who included Prince Charles Lucien Bonaparte, H. Burmeister, Dumeril, G. R. Gray, Herman von Meyer, Milne-Edwards, Strickland, Charles Des Moulins, etc. This "Prefatio" is dated Neocomi Helvetorum, Febr., 1846, only a few days before Agassiz left Neuchâtel for his journey to America. To give an idea of the great labour expended in carrying the work to completion, it will suffice to say that it contains thirty-one thousand names of genera and families alone, with bibliographical quotations numbering thirty-four thousand titles of works or papers on natural history. In all, the number of quotations is more than one hundred and fifty thousand.

Agassiz had collected for his own private use a catalogue of all known works and detailed memoirs on zoölogy and geology; and, before leaving Europe, he made an arrangement with the "Ray Society," of London, to publish it. Professor H. E. Strickland, the successor of Buckland at the Oxford University, was requested to act as editor; but, unhappily, Strickland was accidentally killed, in September, 1853, while geologizing on the track of the Great Northern Railway, at the mouth of the Clanborough Tunnel, near East Retford, before he had finished the publication of the "Bibliographia Zoologiæ et Geologiæ," based on Agassiz's manuscripts; and Sir William Jardine, the eminent naturalist, and father-in-law of the lamented Strickland, completed the editing of the remaining volumes of the

work, which is composed of four octavo volumes, containing the literature of zoölogy and geology until 1846; a most useful publication, dated London, 1848–1854.

In 1845 another memoir on fossil conchology was published by Agassiz, under the title: "Iconographie des coquilles tertiaires réputées identiques avec les espèces vivantes ou dans différents terrains de l'époque tertiaires, accompagnée de la description des espèces nouvelles," in "Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles," Vol. VII. It is, perhaps, the most objectionable paper he ever produced. Starting from a preconceived idea that not a single animal survived a geological epoch, and that no species passed from one formation to another, with his great faculty for differentiating specimens, he easily pointed out a certain number of cases of *Lucina*, *Venus*, *Cytherea*, *Cyprina*, and other acephales, which showed variations, and which, according to his views, demonstrated that the species, instead of being *identical*, were only *analogous*. Deshayes and other conchologists did not accept Agassiz's view, and, in fact, later knowledge has greatly added to the number of species which pass from one formation to another, not only for the tertiary epochs, but also for the Mesozoic and the Paleozoic formations. The complete destruction of faunas and creation of new and entirely different ones, without the survival of a single species, can no longer be defended; more especially in its application to marine animals. As usual, the memoir of Agassiz is beautifully illustrated with fourteen plates, representing with great care all the details of the shells.

During 1845 the last parts of the two translations in French and in German of Sowerby's "Mineral Conchology of Great Britain" were distributed to the few subscribers. The French edition, a large volume with an atlas of 395 coloured plates, is entitled, "Conchologie (*sic*) Minéralogique de la Grande Bretagne," par James Sowerby, "traduction française revue, corrigée et augmentée par L. Agassiz." The German edition entitled, "James Sowerby's Mineral-Conchologie Grossbritanniens, etc., Deutsch bearbeitet von Ed. Desor. Durchgesehen und mit Anmerkungen und Berichtigungen versehen von Dr. L. Agassiz," is also composed of a large volume, with the same atlas of 395 coloured plates. Although the price was considerably lower than that of the original English edition, the two translations did not sell well; especially the French edition, which was and has remained almost absolutely unknown. The undertaking was a great mistake in every way, and both works have remained a drug in the market.

Generally, as years pass, or after the death of an author, some of his publications become rare and valuable, and command a higher price than was asked at the time of their issue. With Agassiz's publications, however, this is not the case; not a single one of his European works is now quoted above, or even at, its price of publication. All are discounted with a fair reduction from the original price, and can be obtained easily of any bookseller in Europe. The same thing has happened also in the case of all his publications in America, with the single exception of his volume on

"Lake Superior," the value of which has risen to two and even three times the price asked by the publisher, when it came out in 1850, and it is now difficult to procure a copy. The explanation of this in the case of some of Agassiz's works, which are really of great scientific value, is, that in their desire to help him, many persons were ready to pay any price asked, and consequently almost all his publications were issued at rather high prices; while others of his publications, although they were expensive, were either not really needed, like the translations of Buckland's and Sowerby's works, or were limited to a too small circle of naturalists to secure a large sale.

Better management would have prevented Agassiz from running into debt on account of his numerous publications. At the same time that he was issuing his works with such losses, works of the same sort were published in France, not only without loss, but even with profit from the very beginning of the undertaking. I refer to the great work of Deshayes, "Description des Coquilles fossiles des Environs de Paris," and more especially the "Paléontologie française," by Alcide d'Orbigny. Agassiz differed from them, also, in his method of working, and in his domestic arrangements, for both Deshayes and d'Orbigny worked alone, without assistants of any sort, except their artists; and their establishments at Paris were extremely modest, and limited to what was strictly necessary.

In 1845 the pecuniary position of Agassiz became very serious, and his family were obliged to come to his assistance, which they did with great generosity. All

his numerous and bulky publications were put into the hands of the rich firm of Jent and Gassmann, booksellers and publishers at Solothurn; securities were given to his creditors, and everything was most honourably arranged to relieve him from his immediate distressing position.

If, however, his Neuchâtel establishment was a failure pecuniarily, scientifically it was a success unique in natural history. The result of his fourteen years' residence at Neuchâtel was the publication of more than twenty volumes, with two thousand folio or octavo plates, and many separate papers; all were well written, beautifully printed, and profusely illustrated with most exact drawings — a record so creditable that it gave a just celebrity, not only to Agassiz, but also to Neuchâtel, at that time a small town of less than six thousand inhabitants. The "Neuchâtelois" may well be proud of such a performance; their great liberality toward science, and their appreciation of the rare value of Agassiz, made it possible for him to prosecute with unimpaired vigour his remarkable scientific researches famed the world over.

That Agassiz thought that he was acting wisely in receiving Vogt and Desor at his table as regular boarders, and giving a room in his apartment to Desor, there is no doubt. But, in the long run, the scheme proved expensive, and most harassing to his wife. Little by little, the characters of both Vogt and Desor came out; jokes of doubtful politeness were indulged in; remarks rather satirical, cynical, and anti-religious were not rare. Vogt, more especially, never missed an opportunity to make a "bon mot" at the expense of the

Bible, turning into ridicule all religious beliefs and practices. Mrs. Agassiz, being a religious woman and bred in a totally different atmosphere in her own home at Carlsruhe, was very sensitive to these sarcasms. Finally expenses and difficulties reached such a climax that a crisis became inevitable. Mrs. Agassiz's health was poor; and the announcement, by newspaper, all over Germany, of a royal gift by the king of Prussia to allow Agassiz to make a journey to America, was hailed as a proper moment to join her own family at Carlsruhe.

In a letter, dated Carlsruhe, 16th of March, 1845, her devoted brother, Alexander Braun, wrote that all was ready at his home to receive her. (Alexander Braun's "Leben," pp. 378, 379.) Taking her children with her, first on a visit to the excellent mother of Agassiz at Cudrefin, at the old Dr. Mayor's house, Mrs. Agassiz then left Neuchâtel early in May. It is the most painful incident in the life of the great naturalist. That misunderstandings and difficulties developed mainly by extravagance in the interest of natural history should have had such a final result, is most pitiable and to be regretted. These explanations are not meant to excuse the faults committed by Agassiz at this time of his life; they show, however, how he fell into errors, and how he might easily have avoided them. They have been rendered necessary by what has been said, rather bitterly, by the biographer of Desor ("Edward Desor: Lebensbild eines Naturforschers," von Karl Vogt, Breslau, 1882).

In the spring of 1845, Agassiz delivered his last public course of twelve lectures on the "Plan de la Création," showing the successive development of organized beings. It was followed with more attention and by a more numerous audience than any of his previous annual series of lectures. The news that he was to undertake a journey to the New World under the auspices, and with the help of the king of Prussia and prince of Neuchâtel, who contributed from his private purse three thousand dollars, caused a surprise mingled with fear that he would probably never return to resume his position at Neuchâtel. Everybody in Neuchâtel highly appreciated, not only the great savant who was truly the founder of the Academy, — which, but for him, would not have been established for years, — but also the friend and charmer so highly esteemed and beloved, and went anxiously to hear him once more; anticipating, with good reason, that this last course might be regarded as his scientific testament.

Agassiz took care to dictate his last lecture, and published it in the first number of the "Revue Suisse," just transferred from Lausanne to Neuchâtel, in August, 1845. The title of the lecture is: "Notice sur la Géographie des Animaux, par L. Agassiz"; and it begins with the following sentence: "All organized beings, plants as well as animals, are confined to a special area [or, as he calls it, "ont une patrie"]. Man alone is spread over the whole surface of the earth." Strange to say, one of his first impressions, after studying the different races of man he met with in America, led him to reverse this opinion, and a few years later he pub-

lished his remarkable and scientifically very frank paper, "Sketch of the Natural Provinces of the Animal World and their Relation to the Different Types of Man," Cambridge, 1853. Agassiz was too good a naturalist, too much accustomed to differentiate animals, to accept unity in the genus *Homo*, and when converted to the views of Dr. Samuel Morton of Philadelphia on the different types and diversity of man, he frankly proclaimed his change of opinion to the scientific world, with the same earnestness with which eight years previously he maintained the old creed of a unique species; and when, a few years later, he heard of the discoveries of the fossil man of the Quaternary epoch, he accepted it at once, delighted to learn that a man was in existence and saw the great glaciers, of which he was the first to conceive the existence before the present epoch.

I may add a personal reminiscence of the first time I saw Agassiz, when I presented to him a letter of introduction from his friend Jules Thurmann. He had close by him on his desk a pile of copies of this notice on the geography of animals, and taking one, he wrote my name on the cover, and offered it to me. I have ever kept that first gift of Agassiz — followed by many others, for he always from that time gave me all his publications — as a souvenir of one of the most fascinating men I have met in my life; for such was the impression he made on me; an impression which has remained unimpaired, and indeed constantly deepened, until the last day of his life.

During 1845, the friendship which had existed for at

least twelve years with Jules Pictet de la Rive of Geneva, became intimacy, and remained so until the end. These two savants had many similar qualities, and it is not surprising that when they met they became the best of friends. For Pictet life was never difficult. Son of an old and wealthy family, he married early the granddaughter of the celebrated Madame Necker-de-Saussure, and became one of the richest men of Geneva; while, on the contrary, Agassiz had to struggle all his life against poverty. However, both of them spent largely for science, and were never so happy as when they were able to secure at any price rare and well-preserved natural history specimens. Although rich, Pictet always worked very hard, being second only to Agassiz in this respect, and not far behind him. He conceived and published the first manual of palæontology in four volumes; and the first copy was sent to Agassiz, who wrote at once a review of it for the "Bibliothèque Universelle." The following is a letter from Agassiz on the subject: —

NEUCHÂTEL, 7 Mai, 1845.

F. J. PICTET,
Genève.

Mon cher ami, — C'est à vous plutôt qu'à Monsieur de la Rive que j'adresse l'analyse que je viens de faire de votre ouvrage ("Traité élémentaire de Paléontologie"). Vous voyez que j'ai tenu parole de ne prendre que le temps matériellement nécessaire à sa lecture pour la rediger. Aussi ma notice doit se ressentir de cette précipitation, et c'est ce qui m'a fait décider de vous la soumettre d'abord. Corrigez et changez ce que vous voudrez, je n'ai pas l'esprit assez reposé pour avoir pu faire quelque chose de complet, quoique j'aie lu votre beau livre bien attentivement. Je ne doute pas que cet

ouvrage n'ait un grand succès, et je vous engagerais fort à en provoquer la traduction en anglais et en allemand.

J'aurais eu un chapitre à écrire sur la nature des progrès organiques, réalisés dans la série des terrains, mais cela m'aurait entrainé à m'écarter trop de votre ouvrage, et c'est ce que je n'ai pas voulu faire.

Vous seriez bien aimable de venir me voir bientôt; quant à moi je doute de pouvoir aller encore une fois à Genève; je suis accablé de travail. Mais proposez cette course à Favre et venez bientôt; ce serait un grand bonheur pour moi de vous revoir avant mon départ qui est fixé à la fin de Juin. [He did not leave, however, until ten months later.]

Je vous enverrai sous peu un long mémoire sur la question des Coquilles Tertiaires réputées identiques avec les vivantes, que je viens de faire imprimer.

Mille amitiés à M. de la Rive. J'ai d'excellentes nouvelles de Vogt, qui travaille comme un forcené à Paris, je lui ferai parvenir l'exemplaire du Traité (de Paléontologie) que vous lui destinez et qu'il n'a sûrement pas davantage que moi.

Votre tout dévoué,

LS. AGASSIZ.

Dites moi si vous me pardonnez mes critiques.

A last visit to the glacier of the Aar, at the beginning of August, 1845, was made in order to transfer all the observations to Daniel Dollfus-Ausset, who had generously offered to continue them at his own expense, and who did so with great perseverance, during sixteen years, until 1861. (See "Glaciers en activité," in "Matériaux pour l'Étude des Glaciers," par Dollfus-Ausset, Vol. V., Paris, 1870.)

As soon as Agassiz returned to Neuchâtel, he again left to attend the annual meeting of the Helvetian Society of Natural Sciences, held at Geneva the 11th, 12th, and 13th of August, 1845. There, although only

a middle-aged man, he seemed like the leader of the meeting. He spoke first, at the general session, on the structure of the fins of fishes; and then, at the special sections of physics, he gave an account of his researches during the last three years on the glacier of the Aar, dealing more especially with the motion of the glacier, its structure, the ablation of the surface, the meteorology, etc. Discussion followed, in which Jean de Charpentier, the founder of the glacial theory, and Venetz, son of the first promoter and discoverer of the existence of ancient and immense glaciers in the Rhone valley, took part and gave new proofs of the great value now attached to their first observations. Leopold von Buch, present at the meeting, did not approve all that he heard respecting glaciers, and left, rather indignant at the evidence of the great progress made; for at this time, all the Geneva naturalists, with the exception of Jean André de Luc, then an octogenarian, were converted to the new theory. Arriving at Zürich a few days after the meeting was over, von Buch called on Arnold Escher von der Linth, as he was accustomed to do almost annually, and begged Escher to take him on an excursion among the Alps of the Primitive Cantons of Switzerland, making the one condition, however, that Escher would not once speak of anything relating to glaciers and glacial action. Escher, who respected and loved von Buch, as the best friend of his deceased father, promised, and kept his word, notwithstanding that he was himself one of the best and first-converted glacialists, and that at every step he found most undeniable proofs of the great extension of glaciers. A few

years later, Escher told me that it required the greatest self-control he was ever able to exercise; and that nothing could induce him to attempt it again.

But to return to the Geneva meeting: Agassiz made a third communication on the brain of fishes, and noted the existence of a very large pot-hole ("Marmite des Géants") above the Handeck Fall in the Bernese Alps. At the great dinner, given to the Helvetian Society at the "Hôtel de la Navigation," Agassiz was toasted, with the following remarks: "To the learned and amiable professor of Neuchâtel, M. Agassiz, who is on the point of undertaking a far-distant journey, where our sympathies will follow him," etc.

The impression made on Agassiz was very strong, as shown by the letter he immediately wrote to Pictet: —

NEUCHÂTEL, le 16 Août, 1845.

JULES PICTET,
Genève.

Mon cher ami, — Je ne veux pas tarder à vous envoyer Miller ("The Old Red Sandstone"), afin que vous le receviez avant votre départ pour Naples. Renvoyez moi le dès que vous le pourrez.

Je suis rentré chez moi hier, comme je me l'étais proposé, et j'ai trouvé ma mère qui m'attendait déjà depuis la veille; vous voyez que c'eut été très mal de ma part de prolonger mon séjour à Genève. Il fallait vraiment un pareil motif pour me donner la force de me séparer de vous. Cette réunion a laissé dans mon cœur des souvenirs ineffaçables; veuillez répéter encore à tous nos amis communs, et en particulier à M. de la Rive, à Favre, à M. Marcet, combien j'ai été touché de leur accueil amical et de toutes les marques d'amitié qu'ils m'ont données.

J'ai déjà parcouru quelques feuilles de votre troisième volume (*Traité de Paléontologie*); plus j'apprends à connaître votre livre, et plus je suis convaincu qu'il aura un grand succès. . . . A propos,

j'ai oublié de vous demander si vous avez donné suite à la demande qui vous a été faite de rédiger une notice biographique sur mon compte, dans la *Revue Romande* ou je ne sais quel autre recueil. Si cela est, dites-moi où je la trouverai.

Votre tout dévoué,

Ls. Agassiz.

The biography by Pictet, with an excellent portrait of Agassiz, was communicated in manuscript to Agassiz, who, in returning it, wrote in the following terms: —

Neuchâtel, 25 Août, 1845.

Jules Pictet,
Genève.

Remarques:

Verso de page 1. — "Cette correction, etc."; à effacer, on pourrait croire que mon père m'avait à demi assommé,[1] et personne n'était moins sévère que lui.

Page 2. — "d'eau douce"; ajoutez: pour lequel il recueillit d'importants matériaux dans le Rhin et dans le Necker, qu'il put comparer plus tard avec ceux du Danube et de l'Isère, pendant son séjour à Munich et à Vienne.

Verso de page 2. — Ajoutez au bas de la page: Ce goût pour l'observation fut encore augmenté par les nombreux voyages qu'il fit dans le midi de l'Allemagne, et en particulier dans les Alpes du Tyrol, où il se familiarisa avec l'étude des plantes, sous la direction d'un de ses condisciples, M. Alex. Braun, devenu depuis botaniste distingué. Ces connaissances lui furent plus tard d'une immense utilité pour l'étude des plantes fossiles.

Page 4. — "Vogt." La large part que j'ai faite à Vogt dans la publication de l'embryologie des Salmones, que nous avons poursuivie pendant toute une saison en commun, et que je l'ai chargé plus tard de terminer, tandis que j'aurais été pleinement en droit d'après

[1] Here is the corrected sentence: "Il (Agassiz) raconte lui-même que l'amour de la pêche l'entraînait quelquefois trop loin, et que la seule punition qu'il reçut jamais de son père lui fut infligé parce qu'il s'était imprudemment embarqué dans un petit bateau pour la pêche du brochet."

ces antécédents de les publier sous nos noms réunis, ne doit pas être un motif pour m'exclure de toute participation à ce travail; ainsi modifiez légèrement cet article, d'après la préface de l'ouvrage rédigée par Vogt lui-même.

Page 9. — Vous citez ici pour la deuxième fois l'ouvrage de Charpentier et vous ne mentionnez pas même le mien qui était déjà, lorsqu'il parut en 1840, appuyé sur plus de faits que ceux que décrit Charpentier. J'y donne déjà des chiffres, et les premières planches que l'on ait possédées sur les glaciers, faites en vue de faire connaître leur structure, la disposition des moraines, l'action des glaciers sur le sol, les roches polies, etc., etc.

Ce fut déjà en 1840 que j'allai visiter l'Écosse pour y chercher des traces de glaciers et que je démontrai leur présence dans une foule de ces belles vallées, tant d'après l'arrangement des moraines qui les traversent, que d'après la nature des polis de leurs parois rocheuses et des galets de leur fond. Je les observai aussi en Irlande, en Angleterre dans la région des lacs, et plus tard dans la Forêt Noire. Et c'est à ces observations qu'est dû l'intérêt général qu'a pris la question des glaciers.

Dernière page. — Ajoutez: Sous les auspices et aux frais du Roi de Prusse, auquel j'ai dû de flatteuses distinctions, ou quelque chose d'analogue ; ce sera utile pour l'avenir.[1]

Voilà bien des observations, mon cher ami, mais vous les introduirez encore plus brièvement dans votre notice qui me fait grand plaisir, et pour laquelle je vous remercie vivement. Si j'ai fait une petite note pour les *Études sur les glaciers*, c'est que j'ai le sentiment qu'à l'égard de ce livre, on n'a pas été juste à mon égard et que de toutes parts on lui a jeté la pierre contre; les uns disent que j'en avais emprunté le contenu à M. de Charpentier que je n'avais pas pourtant visité qu'en 1836, tandis que mon ouvrage est de 1840, et est le résultat de mes courses et de mes observations propres; de là la divergence sur tant de points avec de Charpentier qui n'a publié qu'un an plus tard; les autres, et Forbes en particulier, même en 1842, m'ont refusé la connaissance de tout fait qui n'était pas

[1] It is evident that Agassiz, at that time, still hoped to be called to a professorship in the University of Berlin.

mentionné dans mes *Études* et cela même pour des faits que je leur ai montrés le premier. Ce n'est donc pas pour une misérable gloriole que je réclame, mais par un sentiment de justice.

Demain ou après-demain je vous enverrai mes *Myes*.

Adieu, mon cher ami.

Tout à vous,

Ls. Agassiz.

P.S. — Voudriez-vous dire à Favre ou à son frère, si Alphonse est aux Diablerets, qu'alors même que je ne réponds pas immédiatement à sa lettre, il peut compter que je lui donnerai les renseignements qu'il me demande pour son voyage dans le Nord, avant mon départ.

Pourrais-je obtenir de l'éditeur de votre notice d'en avoir quelques exemplaires pour distribuer à mes amis?

Adieu, bon voyage si vous allez à Naples, mes amitiés au Prince de Canino.

The biography of Agassiz by Pictet is almost unknown, on account of its publication in an album, which had a very limited circulation, confined to French Switzerland, and among a circle of subscribers residing in villas round the shore of the Lake of Geneva. Of the many biographical notices, published either during the life or after the death of Agassiz, it is by far the best; and I cannot do better than to quote the first and last sentences, — two admirable pages of true and just homage to the great naturalist. Pictet says: —

Parmi les savants dont la Suisse a pu avec raison s'honorer dans ces dernières années, Agassiz est certainement un de ceux dont la réputation est la plus populaire. Des travaux scientifiques remarquables, empreints de ce mélange d'imagination et de jugement qui caractérise les créations brillantes et durables, une grande persévérance dans l'étude des faits, une éloquence chaleureuse et entraînante, justifient amplement cette réputation, à laquelle ses études sur les glaciers, plus à la portée de tout le monde que ses

autres travaux, ont ajouté un nouvel éclat. Qui, en effet, parmi les amis des Alpes, ne s'est pas intéressé à cette petite réunion d'hommes, liés par l'amour de la science, transportant leur laboratoire dans ces Hautes Régions Glacées, décrivant en artistes les beautés spéciales de ces vastes solitudes, y exercant une large hospitalité et déployant dans leurs travaux une persévérance, une ardeur et quelquefois une hardiesse bien faite pour captiver l'attention des plus indifférents ? . . . Nous avons cherché à esquisser ici la vie déjà si remplie de notre savant compatriote, nous aurions voulu oser pénétrer encore plus avant, et raconter à ceux qui ne le connaissent pas, son caractère aimable et attachant, son ardeur dans tout ce qu'il entreprend, sa vivacité dans la discussion unie à la politesse du cœur et en un mot toutes les qualités qui lui ont créé partout des amis et qui l'ont fait l'âme de réunions des naturalistes suisses qu'il vivifie par sa présence.

Such appreciation, coming from so independent and just a naturalist as Jules Pictet de la Rive, shows what a strong hold Agassiz had upon his countrymen, when hardly in middle life; indeed, before he was forty years old. Every one in Switzerland felt that so small and modest a place as Neuchâtel could not retain him any longer. Even Swiss naturalists saw plainly that Switzerland was too small a field for the indefatigable activity of a man so gifted, and that his proper place was either at Paris, or in a new and great country like the United States of America; and when he left, everybody knew that it was a final departure, and that Agassiz was lost to the fatherland.

Agassiz's letter to Pictet is also most important, because it gives an inside view of several occurrences, more especially of the difficulty with de Charpentier. Agassiz did not realize the impression made on many by the impropriety of his publishing before de Charpen-

tier a volume of "Études des Glaciers." Many of Agassiz's best friends regretted it sincerely, and there is no doubt that it was a mistake on his part not to have waited until de Charpentier had issued his volume.

A last duty remained to perform before saying good by to Neuchâtel. It was to return all the specimens of fossils so generously lent by public establishments and private individuals for his palæontological works. It was not a small undertaking; for Agassiz, with his eagerness to collect all the material he wanted, asked for and collected around him a quantity of specimens which he was unable to make use of. However, everything was carefully packed and sent safely to its destination with the thanks of the professor. And since that time all such specimens are quoted in both public or private collections as determined by Agassiz; every one being justly proud to have helped the author of the "Poissons fossiles," of the "Echinodermes," and of the "Myes."

CHAPTER XI.

1846.

Departure from Neuchâtel, March, 1846 — Arrival in Paris and Sojourn at the "Hôtel du Jardin du Roi" — "Nouvelles Études sur les Glaciers actuels" — The Glacial Theory before the Geological Society of France, at the Meeting of the 6th of April, 1846 — Agassiz's "Catalogue Raisonné des Echinodermes" — His Work in the "Galerie de Zoologie" and among the Private Collections of Brongniart, de France, Deshayes, d'Orbigny, de Verneuil, etc. — Desor's Presumption, in putting his Name on the Title Page, without Agassiz's Knowledge — Attentions paid to Agassiz by Thiers — Indirect Offer of Official Positions at Paris declined — Short Visit to England, to meet Charles Lyell — On a Cunard Steamship from Liverpool to Boston.

At the beginning of March, 1846, Agassiz left Neuchâtel, never to return, except for a single very short visit, of a few days, in 1859. At two o'clock in the morning, he took the stage for Bâle, en route for Carlsruhe; and, notwithstanding the early hour, the post-yard was filled with his many friends, colleagues, and students, the last coming in a body, with torch-lights, and giving him a parting serenade. Although he spoke of his return, and of resuming his scientific work at Neuchâtel, every one felt that the departure was momentous, and that Neuchâtel was losing the man who had given it a world-wide reputation as a

centre of science, never before equalled in Switzerland, in connection with such a small town, such a limited academy, and in so short a time.

In order to understand what follows, it is necessary to say a few words concerning the material difficulties under which Agassiz laboured during his fourteen years' residence at Neuchâtel. His very small salary, of eighty louis (Neuchâtel currency), and a few years later of one hundred and sixty louis, was hardly sufficient to defray his household expenses, even if he had limited them strictly to his family. But very soon he largely increased all his expenditure, both for his publications and for his assistants. At first, his sister and wife helped him, and his friend Louis de Coulon assisted him in bibliographic work, and in collecting under his direction. But when he became interested in glaciers and the glacial question, it was too great a task for his voluntary assistants, and, in addition, new duties obliged Mrs. Agassiz to give up drawing and writing for her husband. If Agassiz was an indefatigable worker, when busied in the observation of new facts, he was too impatient, and always carried too far by new schemes, to write books, or even memoirs. As he himself says, it was very difficult for him to sit down at his desk and write all he had observed and knew on a subject. "Je ne suis pas un cul de plomb comme Richard Owen," the great English palæontologist. He always envied this faculty, so strongly characteristic of Professor Owen. But it was vain for him to try to acquire it, for he soon fretted, was extremely nervous, and finally left the work to

others to finish, or abandoned it altogether, never returning to it. With such a disposition, Agassiz was much in need of a secretary and assistants able to understand his instructions and to carry out and finish his numerous schemes. He successively added several assistants. In fact, the apartment of the professor was a sort of "Pension bourgeoise" for naturalists and artists; for, besides the regular inmates, there was a constant arrival of friends, and of members of the Agassiz family, who were quite numerous around Neuchâtel, and of foreign naturalists, such as the two Schimpers and the two Braun brothers. Of course, the one hundred and sixty louis of his salary were soon exhausted in keeping such an establishment, and needed additions of money were lacking all the time. Agassiz very quickly expended his share of his inheritance from his father, and then all his family were obliged to help him; which they did at first with pleasure, and afterward with some reluctance.

The Neuchâtel burgesses, and more especially all the wealthy families, who had contributed to the subscription for founding his professorship of natural history, were ready to help him, and very generously contributed money for each new scheme brought before them by Agassiz. But as soon as one scheme was fairly started, another, absolutely unexpected, was added to the burden. And, as one of the most liberal of those naturalists of Neuchâtel says, "We were ready to help Agassiz with money; but there was no end to his constant needs. He had already expended, in advance, all we were glad to

offer him, et c'était toujours à recommencer." In fact, Agassiz had exhausted all his credit, when he left Neuchâtel, having made use, one after another, of each of his friends, and of his whole family. And all for science! for he had few needs, and was by no means extravagant in personal expenses. Always generous when he had money in his hands, he distributed it to his assistants, draughtsmen, and lithographers, never thinking of himself and of his own family, until all others had been supplied. On the whole, Agassiz was a very rare character, — always hopeful, but a great dreamer; and he acted, all his life, as if he knew with certainty that a great lump of gold belonging to him was lying somewhere behind an enormous boulder, and that he had only to extend his hand behind the boulder, and fill his pockets with as much as he wanted. And, curiously enough, this dream of his was fully realized, only it was at the end of his life, and for the benefit of his children. And so was fulfilled Humboldt's prediction, in a letter dated Berlin, June 17, 1838, that "he was certain that there was gold somewhere in his *polished rocks*. I should like to find the secret which you possess, to work all those mines." For it is under, and even in, *polished rocks* of the great North American glacier extending from Greenland to Minnesota that Agassiz's great gold lump lay.

When Agassiz left Neuchâtel, it was arranged that Desor and Girard should pack up about two hundred volumes, — the most necessary works for reference on glaciers and fossil echinoderms, — and leave all the rest of Agassiz's already large library in charge of

William Hüber, the librarian, with directions to continue the bibliographic collection of titles for Agassiz's great manuscript list, forming his "Bibliographia Zoologiæ et Geologiæ," and then hasten to Paris to meet Agassiz on his arrival there.

The son, Alexander, then a boy of eleven years, was left at Neuchâtel, to pursue his studies at the College. The two daughters and Mrs. Agassiz were already living at Carlsruhe with Alexander Braun, the always trusted friend of Agassiz and the excellent brother of his wife. Having disposed as satisfactorily as possible of all his affairs and the numerous persons more or less dependent on him, Agassiz took his departure, with a heavy heart and great anxiety as to his future. He knew too well that it was impossible for him to return and assume again the same position, — a position inadequate to his wants and his aspirations as a savant and as the head of a family. The world was open before him, to be sure; but all was uncertainty. However, his will was strong to conquer a position; and with that determination constantly in view, he began life again at the ripe age of thirty-nine years.

After a few days passed with his family at Carlsruhe, Agassiz arrived in Paris at the end of March, staying, as he was accustomed to do, at the old "Hôtel du Jardin du Roi," rue Copau (now rue Lacépède), near the Jardin des Plantes. There he was received by Desor and Girard, to whom were added Karl Vogt, at that time a resident of the hotel, and Dickmann, one of Agassiz's artists.

At once Agassiz started several works; first, an

octavo volume on the glaciers, and second, a "Catalogue raisonné des Echinodermes vivants et fossils." After his publication of "Études sur les Glaciers" (1840), Agassiz began in 1841 a new series of researches and observations on the structure of ice, the temperature, the annual progression, and the daily movement of glaciers; and it was the result of these four years of constant study on the glacier of the Aar that he wished to present to the scientific world.

A well-known Paris publisher, M. Victor Masson, purchased Agassiz's manuscript, the first fruit of his arduous toil that Agassiz had succeeded in thus disposing of; but, unhappily, the transaction proved an unfortunate one for the publisher, who lost heavily, the failure being due partly to political trouble in France in 1848, a short time after the work was issued, partly to its incompleteness. According to the announcement, it was to be composed of three parts, of which the first only was published; the contemplated second part was to be furnished by Arnold Guyot, on the distribution of boulders round the Alps, and the third part, on the geographical distribution of old glaciers all the world over, by E. Desor. Guyot and Desor contented themselves with a few short papers, published in the "Bulletin de la Société des Sciences Naturelles de Neuchâtel," 1847, on the erratic boulders of the basins of the Rhone, Rhine, and the Pennine Alps; and in the "Bulletin de la Société Géologique de France," on the glacial deposits of Scandinavia, and the erratic or Quaternary of North America.

As usual, Desor wrote the first part, under Agassiz's

direction and supervision. Chapter by chapter, Agassiz looked over the manuscript, correcting with pencil, and indicating additions to be made. The manuscript was finished before Agassiz left Paris, and went to the printer between November, 1846, and April, 1847; first under the direction of Desor, who left Paris at the end of February, 1847, and afterward under the direction of Charles Martins, who wrote the introduction and finished the excellent list of works on the present glaciers. Thus the volume is a rather composite one, through the collaboration of Desor and Martins, and as a whole, is less important than Agassiz's first volume on the glaciers, although it contains many new facts. The truth is, that Agassiz and Desor were not physicists; and although Martins and Bravais, who were good physicists, helped them with their advice at the glacier of the Aar, they failed to recognize the plasticity of glaciers, as Bishop Rendu and James Forbes had done in the case of the Savoy glaciers; and it was reserved for the great English physicist, John Tyndall, to solve the problem of the conversion of snow into ice by pressure, to find the cause of glacier motion in pressure, regelation, crystallization, and internal liquefaction, — a splendid discovery which was made between 1856 and 1859, and published in 1860, in a work entitled "Glaciers of the Alps."

Beside the publication of the volume on the glaciers, Agassiz, during his stay in Paris, greatly advanced the acceptance of the glacial doctrine by all unprejudiced geologists. In a communication made before the Geological Society of France, at the meeting of the 6th of

April, 1846, he discussed, with more care, if possible, than usual, all the plain facts observed on the present glaciers, as regards polishing of rocks, directions of striated marks, "cailloux striés, boue glaciaire," transportation of boulders, etc. For we must keep in mind that everything was contested and often denied by the opponents of the glacial theory. Agassiz had before him, however, an audience suited to his wishes. De Beaumont, the great adversary of glaciers, was there; also de Beaumont's collaborator and right arm, Dufrenoy, besides some partisans of his own views, among them Constant Prévost, Deshayes, Martins, Bravais, Dollfus-Ausset, d'Omalius d'Halloy, and Major Leblanc. It was a very important meeting, for Agassiz was able to answer every objection. De Beaumont, who was always very cunning when in the presence of original and able observers, preserved a discreet silence, and let all the heat of the discussion rest on Dufrenoy, contenting himself with smiling and nodding his approval. It was a curious duel. Dufrenoy, always sceptical, but amiable, and rather inclined to be humorous, asked if the "cailloux striés" were truly a good indication of the existence of old glaciers. "Yes!" was the answer. "They are the characteristic fossils of a glacier." Little by little, the audience of eighty persons, all good geologists, came round to Agassiz's views. It was a marked success; so much so, that de Beaumont left the room before the end of the meeting; and Dufrenoy, when the meeting was over, said aloud to Agassiz, referring to his collaboration and companionship with de Beaumont during twenty-five years,

"Croyez-vous que j'ai été toujours à la noce avec lui;" showing how much he had to endure from the disposition of his colleague in the construction of the Geological Map of France.

On this day the glacial theory at last gained the ascendency in France. De Beaumont, for two years longer, continued an underhanded opposition by means of some of his favourite pupils, Messrs. Durocher and Frappoli. But Charles Martins, a remarkable speaker and good writer, took the question where Agassiz left it, and easily extinguished all opposition. Now it may seem strange to many that such a clear question, with such admirable and visible proofs, should have encountered such a powerful opposition, and arraigned against it such geologists as Alexander von Humboldt, von Buch, Élie de Beaumont, and Murchison. Geology is too vast for any one man, whatever his intellectual capacity and knowledge, to be a good judge and an expert on all the questions which arise. At the beginning of the creation of modern geology it was the custom for every one to give his opinions on each point. In this way, a number of errors were accepted as facts; and it required generations of able observers to remove these great obstacles to the progress of geology. The belief in the transportation of boulders by great mud currents, in connection with the universal deluge of the Mosaic tradition, was so deeply implanted in the minds, even of savants, that it was not an easy task for Venetz, de Charpentier, and Agassiz to uproot it. It laid upon them a quarter of a century of hard work and harder fighting.

From the time of his first establishment at Neuchâtel, Agassiz had taken great interest in the echinoderms, publishing, from 1833 to 1845, numerous and most important memoirs on the subject. His stay at Paris was an opportunity long looked for, and he seized upon it with his usual enthusiasm. All the public and private collections were at his complete disposal. The Jardin des Plantes, with its vast wealth, known and unknown, was thrown open to him. The old gallery of zoölogy, just opposite the "Pitié Hospital" had its best room barricaded; and drawers filled with specimens, barrels of all shapes, containing collections of marine animals from all parts of the world, and never opened until now, were brought from cellars and garrets, and arranged in front of the usual collection of echinoderms exhibited to the public. Agassiz placed the specimens on long tables; and there, with the help of his friend Valenciennes, professor of conchology, and his assistant, Louis Rousseau, — a brother of the great landscape painter, Theodore Rousseau, — he began classification and determination, dictating to his secretary, Desor, the descriptions of families, genera, and species. Sometimes his enthusiasm was raised to perfect rapture, when some new species or a new genus was found in one of the barrels brought up from the Pacific Ocean by exploring expeditions of the end of the last or the beginning of this century. It was interesting and also amusing to see him with a sea-urchin in one hand, and a lens in the other, analyzing each organ and each part of the animal, with that accuracy of description for which he was justly celebrated;

and after looking at the label of the barrel, he would sometimes exclaim, "Why! it was collected by Quoy and Gaimard, or by Humbron, or some one else, on the shore of Tasmania or New Zealand, during the voyage round the world of de Freycinet, or Duperé, or Dumont d'Urville," etc. Happiness beamed on his face; and satisfaction was seen in every movement, exclamation, and posture. What an admirer of natural history objects! It was impossible to resist feeling interest in his work. He excited the curiosity of every one in the gallery, and even the guardians and porters were deeply affected and attracted around the professor. The guardian, or janitor, named Philippe Pothau, so well known by all zoölogists who have studied, or even only passed through the collections of the Jardin des Plantes, was in ecstasy and rapture before Agassiz. He was not accustomed to see such enthusiasm, Valenciennes being the most prosaic and unmovable of men, and all the other professors of the Jardin des Plantes being either very sceptical, or too busy to pay much attention to the treasures under their guardianship.

The private collections at Paris were then more numerous and more important than at the present time. The impulse given to the study of palæontology and geology by Cuvier and his school had not yet died out. His principal collaborator Alexandre Brongniart was still alive; and on two successive Sundays he himself exhibited to Agassiz his fine collection of fossil echinoderms, some of which were the types described by Lamarck and himself in his celebrated "Géologie des Environs de Paris." Defrance, one of the ablest

and most modest of all French palæontologists of the first half of the nineteenth century, was also still alive, and with his printed list of fossil remains entitled, "Tableau des corps organisés fossiles," etc., in his hands, he pointed out each of the echinoderms to Agassiz. Besides those two collections, so important on account of the types they contained, Agassiz studied, one after another, the fine collections of Alcide d'Orbigny, Deshayes, Michelin, Graves, de Verneuil, d'Archiac, as well as the public collections of the École des Mines, la Sorbonne, and the École Normale. It was a rare enjoyment for Agassiz.

He himself wrote, without any aid from his secretary, the "Résumé d'un travail d'ensemble sur l'organisation, la classification et le développement progressif des Echinodermes dans la Série des terrains"; a masterly review of his knowledge of the Echinidæ, and read it before the Academy of Science of the Institute, of which he had been a corresponding member since April, 1839. Printed first in the "Comptes-rendus de l'Académie," Vol. XXIII., it was reprinted with very few alterations and addition in the "Annales des Sciences naturelles," as an introduction to the "Catalogue raisonné des familles, des genres et des espèces de la classe des échinodermes, par MM. L. Agassiz et E. Desor." The secretary and assistant of a savant has no scientific right to authorship in the publications made by the savant, though generally the savant says in the introduction, or in the body of the work, that he has been helped by his assistant. Agassiz refers several times in the introduction of the "Catalogue raisonné

des Echinides," to Desor and his help; and it was the only recognition really due. But Desor, without asking permission, took upon himself to add his name, as one of the two authors of the "Catalogue," a high-handed proceeding which did not come to the knowledge of Agassiz, until May, 1848, when he received the fifty separate copies printed for his private use. It is not surprising that Agassiz resented the presumption and expressed his disapproval in his great work: "Contributions to the Natural History of the United States of America," Vol. I., p. 97, Boston, 1857, in the following terms: "Catalogue raisonné, etc. I quote this paper under my name alone, because that of Mr. Desor, which is added to it, has no right there. It was added by him, after I had left Europe, not only without authority, but even without my learning it, for a whole year. . . . This is one of the most extraordinary cases of plagiarism I know of." Being the most important witness in the case, and the only survivor of all those who had anything to do with that "Catalogue," I shall dispose in a few words of the claims made rather cavalierly by Desor in his "Synopsis des Echinodermes fossiles," p. xv, Réponse à M. Agassiz, Paris, 1858.

Not only was I present many times when Agassiz dictated to Desor the descriptions of genera and species, and accompanied him often in his visits to the private and public collections of echinids in Paris, but it was to me that the manuscript was entrusted by Desor when he started for America, on the last day of February, 1847. About two-thirds of the "Catalogue" — the first eight sheets — had been printed under the supervision

of Desor. I had to correct the proofs of sheets 9, 10, and 11, and besides to write not only the "Addenda," but also the entire "Distribution géologique des échinides fossiles," with many notes and corrections. The memoir was not issued in separate form until January, 1848, and it was I who delivered it to Agassiz at Cambridge, in May, 1848. I remember perfectly the amazement with which Agassiz saw the name of Desor on the cover as one of the authors, and as Agassiz knew the part I also had taken in the memoir, he said: "But you have more right than Desor to put also your name as one of the authors, for you did it entirely without compensation of any sort, only in kindness and friendship." On the whole, it was very presumptuous in Desor, who had assumed the position of *Maire du Palais*, ruling at his will, not only Agassiz's household, but also distributing scientific authorship according to his fancy or private interest. The part taken by him was simply that of a subordinate. Entirely in the pay of Agassiz, he simply wrote, mainly under Agassiz's dictation, the characteristics; added the description of about one hundred species — more or less — and three or four new genera, and also corrected a few errors, which was all a part of his duty as secretary. Agassiz had begun his studies and publications on the echinoderms five or six years before Desor came to Neuchâtel, and when he became Agassiz's secretary he knew absolutely nothing of echinoderms, or even of zoölogy.

The "Catalogue raisonné," etc., notwithstanding its many imperfections, marked great progress when it was published; and has, ever since, served as the basis

of classification of the echinoderms. It is constantly quoted, and will continue to be quoted, just as the "Animaux sans vertèbres" of Lamarck is; and it is one of the great services rendered by Agassiz to zoölogy.

Agassiz was the recipient of all sorts of attention during his stay in Paris. He met many old friends, not only Parisians, but even men from the provinces and from foreign countries, who came to bid him farewell. M. Esprit Requien, the celebrated director of the museum at Avignon, who had communicated all his magnificent collection of fossil fishes, more especially those from the celebrated locality of Aix-en-Provence, for Agassiz's great monograph on the "Poissons fossiles," took lodging at the same hotel, the "Jardin du Roi," in order to see as much of Agassiz as possible. Requien was a rare type of savant: being an archæologist, a numismatologist, and a botanist and zoölogist, and a friend to every one with whom he came in contact, from Stendhal (Beyle), Prosper Mérimée, Adolphe Thiers, De Candolle, and Alcide d'Orbigny, to Agassiz. He possessed that exuberance of word and gesture so characteristic of the Provençal people and so well portrayed by one of their own writers, Alphonse Daudet. Agassiz much enjoyed his visit. There was another Provençal, Adolphe Thiers, who also was much attracted by the charm of Agassiz's society. They had previously met; but it was during Agassiz's present stay in Paris that a true friendship ripened between the two men, and their later correspondence showed many points of resemblance and common interest; both having an unbounded

confidence in their power of conversation and public speech, and being extremely fond of applause and congenial society; they soon came to appreciate one another, and from this time Thiers, influenced by his conversations with Agassiz, became devoted to natural history. At that time, however, he had no leisure to give to it, being absorbed by his history of the Consulate and the Empire, and afterward by his political positions; but as soon as he was free after his Presidency of the third French Republic, he turned to science as a favourite study and consecrated the greater part of the last years of his life to the history of the earth.

There also came to Paris at this time, whether or not attracted by Agassiz it is impossible to say, one who had been a not over-scrupulous opponent of Agassiz on the glaciers, — no other than James D. Forbes, of Edinburgh, — and an attempt was made in his name to effect a reconciliation. After the publication by Agassiz, in 1842, of the history of his difficulties with Forbes, the scientific world, at least on the European continent, had pronounced against the method used by Forbes during and after his visits to the glacier of the Aar as Agassiz's guest. A common friend, Élie de Beaumont, invited Agassiz to a great dinner party to meet Forbes, insisting upon the desire on the part of Forbes to forget the past and be friends again; but Agassiz very politely, though firmly, declined the invitation, feeling that the attacks of Forbes had been marked by too great impropriety to allow of further friendly relations.

During his stay in Paris, it occurred to several of Agassiz's friends and acquaintances, that he might be

induced to settle there permanently. Nothing would have been easier for the French government than to secure his services, if not at once, at least after his engagement with the Lowell Institute in Boston had been filled, and his promises to send collections to Berlin and Neuchâtel, in return for the advance money he had received from the king of Prussia, had been accomplished. For several reasons, the idea of his permanent residence in Paris was not to the taste of the leaders of natural history; although they feasted him, and gave him a Physiological prize of three hundred dollars at the annual meeting of the Institute of France, they feared, that if he became their colleague, he would soon over-shadow them all. In fact, jealousy was at the root of the affair; and although they loudly professed their admiration for the man himself and his work, and were ready to help him in some of his scientific work, they took no proper steps in the direction of keeping him. Nothing was offered in a direct way by the French government; but indirectly it was hinted that if he wanted to settle in Paris, official positions with salary amounting to six thousand francs per annum would be granted to him. Agassiz declined this doubtful offer, and it was probably a great relief to the official zoölogists and geologists to know that he was not to become their rival, and possibly their leader and master as well.

A Swiss artist of Neuchâtel, Fritz Berthoud, then a resident in Paris, took advantage of Agassiz's stay to obtain a full-length portrait of him. The picture, now in the museum at Neuchâtel, represents Agassiz and

his secretary Desor; but the portrait of Agassiz is not good, and the picture, as a work of art, is poor, showing only the good will of the artist.

At the end of August, Agassiz left Paris, going first to London and then to Southampton, where he attended the meeting of the British Association for the Advancement of Sciences, the 10th of September. It was important for him to see Charles Lyell, who had lately returned from his two visits to North America, 1841–1842 and 1845, on June 26, and who had prepared the way for Agassiz, both with Mr. John A. Lowell, the director of the Lowell Institute at Boston, and with American savants in general, as to what might be expected from the visit of such a master and enthusiast in natural history.

During his short stay in England, Agassiz saw plainly that, although all the English leaders of sciences were extremely courteous and friendly to him, it was absolutely useless to expect from them the offer of any scientific position. His habit of going ahead, without regard to the consequences, was too much for English precision. They admired Agassiz; but that was all. Some, even, were ready to help him in a limited pecuniary way, and truly loved the savant, but the "sans-façon" of Agassiz they could not sanction.

At the end of September Agassiz embarked at Liverpool, on a steamer bound to Boston. The passage, as it is usually at about the time of the autumn equinox, was extremely rough; so much so that it was very much prolonged, and created apprehension as to the safety of the steamer. The newspapers even announced

that the steamer was lost; and lamentations on the death of Agassiz were printed and circulated all through Switzerland: several of Agassiz's friends and admirers shed tears on reading the announcement of his tragical and premature death. "What a miserable end," says one of his best Swiss friends, "for poor Agassiz! He was much too valuable a savant to perish in the middle of the ocean."[1] Happily, the report was without foundation; but during the difficult crossing of the Atlantic Agassiz had full time to realize his position. He had left Europe much discouraged and in an extremely serious mood. During the past twenty years, he had acquired a great reputation, but he had had to pay very dear for it. Not only he had worked hard, and had even gone so far as to endanger his social position, but all his numerous publications had involved pecuniary losses, with the exception of the fishes of Martius and Spix of Brazil, and his two works now in the press in Paris, on the glaciers and the echinoderms. He had contracted debts which must be paid; and his position at Neuchâtel was on this account no longer tenable. Besides, he had formed the habit of having six, eight, and ten persons under his control, to help him in his works as assistants, secretary, artists, and lithographers. He had a family of three children to provide

[1] These two sentences may seem, now, rather melodramatic, but they well reflect the impression really produced. It must be remembered that, in 1846, the crossing of the Atlantic in steamships was in its infancy, many extremely serious accidents were then quite common, and steamers disappeared without leaving traces of any sort after them. Besides, in the centre of the continent, as Switzerland is, a journey to America was considered a great and dangerous undertaking.

for and an invalid wife whose health was a cause of great apprehension to all her friends. In addition, his stay in Paris and in England had dissipated all hope, if he had entertained any, of getting there official positions lucrative enough to satisfy his numerous wants and pecuniary obligations.

Success in America was for him a necessity, as he plainly saw, and he resolved to conquer, and bravely and nobly to meet his destiny, whatever came. The first thing for him to do was to master the English language sufficiently to allow him to speak in public and be understood. Ever since his first visit to England in 1834 he had practised more or less in translating and speaking English; but he knew very well, from his various attempts, how difficult it was for him to make himself understood among his English friends. Lyell had told him that it was useless to lecture in America in the French or German languages; for those two languages then were used in very narrow limits, and if he wished to make an impression on the American public, he must speak good English.

During his long journey across the Atlantic, Agassiz began in earnest, not only speaking English all the time, but committing to memory English sentences and repeating them aloud before any one who had the patience to hear him. The captain of the steamer said, "I have never had such a passenger as you, Professor Agassiz"; and like every one else, he was charmed with the great Swiss naturalist. Here again Agassiz's great memory helped him, although no longer so elastic as it had been in his youth; he soon knew a

sufficient number of sentences and words to allow him to attempt public speaking, as we shall presently see. However, it was too late in life for him to become a complete master of the English language, as he was of the German. He never spoke correct English, and he always retained a strong French accent, which was not without some charm to his listeners.

CHAPTER XII.

1846 (*continued*)–1847.

Arrival in America, and Reception by Mr. John A. Lowell — Condition of Natural History in the United States — His First Visit to New York — His Acquaintance with Dr. Samuel Morton, of Philadelphia — Collections of Captain Wilkes made during his Expedition round the World, seen at Washington — Science at the Capital of the United States — Agassiz's First Series of Lectures before the Lowell Institute at Boston — His Success — A Course on the Glaciers, in French — Frank de Pourtalès joins him — Charleston, South Carolina — His Observations on the Negroes — His Disapproval of Slavery — Arrival at New York of his two Assistants, Desor and Girard. — Establishment at East Boston — Sickness of Agassiz — His Hospitality — A Visit to Niagara Falls — On Board the United States Coast Survey Steamer, the "Bibb" — Arrival of Minister Charles Louis Philippe Christinat — First Difficulties with his Secretary — Two Letters to J. Marcou, extending an Invitation to join him.

One fine morning in the first week of October, 1846, a stranger recently disembarked was seen in the streets of Boston, looking to the right and left, in some astonishment, but steadily making his way to Pemberton Square, a rectangle with a garden in the centre, and surrounded by fine three-storied brick houses, at that time a very aristocratic part of the city, recalling many squares and circles of the London West End. After looking at the numbers of several houses, the foreigner

pulled the bell at the door of Mr. John A. Lowell, who, on opening the door, was surprised to have a stranger, with a strong foreign accent, ask if Mr. Lowell was at home. The astonishment was quickly changed into undisguised satisfaction when the stranger added: "I—a-m P-r-o-f-es-s-or A-g-a-a-ss-i-z," with the drawling pronunciation so characteristic of Romand or French Switzerland, and more specially of Neuchâtel. Mr. Lowell very cordially extended both hands, and congratulated him on his safe arrival; and, in this auspicious manner, Agassiz made his entry into American life, and was launched into American society.

Lowell, with his keen eyes, his knowledge of European life and society, his association with savants, was very favourably impressed by Agassiz. He saw at once that his friends, Charles and Lady Lyell, had not overstrained the praise they had bestowed on the scientific worth of the savant they had so highly recommended to him; and from that first day he became an ardent supporter, and soon after a most intimate friend and counsellor, of Agassiz.

This day was certainly one of the happiest of Agassiz's life. A new life was opened to him at a moment of great mental depression and despondency, the natural result of the difficult position in which he was placed, both pecuniarily and socially.

The moment of his arrival in the New World was particularly fortunate and well timed. Until then the United States had developed without borrowing much from Europe. After the founding of the New England and Virginia colonies and the war of indepen-

dence, American society, isolated and separated by the broad and stormy Atlantic, had been left to its own resources. At first a new society is necessarily limited to material progress, with sound moral and religious training; but sciences and the fine arts are not yet needed. Some scattered naturalists had here and there sprung up, but were not appreciated in proportion to their real merits, and were obliged to publish their observations in Europe, as was the case with the great ornithologist, Audubon. However, now that the great Napoleonic wars were over, a sort of revival in scientific researches and studies had begun. The American savants were not numerous enough to influence society; but a general desire to make scientific discoveries and to try what Americans could do for themselves in this field of human knowledge, illustrated by Buffon, Linné, Cuvier, Lamarck, de Candolle, etc., had already begun to exhibit signs of activity. Local scientific societies had sprung up at Philadelphia, Boston, New York, and Washington, and essays in scientific periodical publication, although not prosperous, because as yet a little premature, had shown that American savants, and especially American geologists, were desirous to enter the arena.

Curiously enough, science entered America led by geology. To be sure, botany, ornithology, conchology, entomology, and other branches of zoölogy, had some representatives scattered all along the Atlantic borders, and even as far west as New Harmony (then in the Indian Territory) in the Ohio Valley, but they were not only isolated, but also without the support of the people.

Public opinion did not encourage them. This was not the case with geology. People in general, and agriculturists in particular, soon showed an eager desire to know the resources of the soils, the rocks, and the mines. Geological surveys were started at the expense of the State in North Carolina, Virginia, Maryland, Pennsylvania, New Jersey, the New England States, New York, and Ohio. A desire to agree on points of classification and to know one another brought together the state geologists, who founded in 1840 the "Association of American Geologists," the first national scientific organization, and which held its meetings at different places in the Union.

The two visits of Lyell in 1841 and 1845, and the important journey of de Verneuil in 1846, among the palæozoic formations from the State of New York and Canada, to the Ohio Valley, the Upper Mississippi River, and Lake Superior, had given a strong impulse to geological researches, in bringing about the much needed comparison with European classification and synchronism. The field was well prepared, if not zoölogically, at least palæontologically, to receive one of the greatest palæontologists hitherto produced by Europe. The coming of Agassiz was anticipated with great joy by all American naturalists, and the more so, because at first his stay was announced to be only temporary.

After a few weeks spent in Boston, making the acquaintance of the Boston naturalists, and visiting the surrounding country, more especially the seashores and beaches, Agassiz went to New Haven, New York, Princeton, Philadelphia, Washington, and Albany. In

this, his first experience, everything was new to him, — the people, the natural history, and American customs and society, — and his first impressions were most encouraging. With his extraordinary penetration and far-seeing vision, he realized what stores of scientific problems were in readiness, wanting only a little push to start the whole machinery of thorough researches over half a continent. It was just the work for him; American natural history had found its leader.

When I said that Agassiz was much encouraged by what he saw of American society, during October and November, 1846, it must not be understood that it was the fashionable world which he saw — rather limited although it was then, in comparison to what it is now. During the first five or six years of his life in America Agassiz paid very little attention to what is called fashionable society; he even avoided it, reserving his letters of introduction, and taking care to deliver them only at the last moment of his stay in New York and Washington, in order to escape invitations. His time was too precious to allow dissipation of any sort; so much so, that, on his first day in New York, instead of examining the magnificent bay and great city, he begged his cousin, Auguste Mayor, a resident of Brooklyn, to take him far up Greenwich Street, to the home of the only American palæo-ichthyologist, Mr. W. C. Redfield, and there he passed a part of the day, looking at fossil fishes.

His means did not allow him to go to first-class hotels, and he patronized second- and even third-class houses, or, more accurately, inns, as they were then, at Albany,

Philadelphia, and Washington. He readily adapted himself to American fare, except in one particular. Born in a wine country, even the excellent beer of Bavaria, during his long and numerous stays in Germany, was never much relished by him; and to be reduced to ice water and tea was rather hard. However, he was obliged often, too often for his inclination, to do the best he could, contenting himself with an occasional glass of claret, and a cup of black coffee, if obtainable, which was seldom the case. But as soon as he possessed a home, he provided light red wine and black coffee at luncheon and dinner, and adhered to this custom until the last day of his life. He never drank freely of strong wine, like the Spanish, Madeira, and Portuguese wines, and was averse to liquors of any sorts, excepting a small glass of "Chartreuse" or very old Cognac, when in company. Agassiz came to America too late in life to change this part of his diet.

At Princeton, Agassiz met, for the first time, Professor Joseph Henry, an American savant, who became one of his best friends and a constant admirer. Professor Asa Gray of Cambridge was there also, at the house of the then most celebrated botanist in the United States, Professor Torrey; and together Agassiz and Gray started for Philadelphia and Washington. Agassiz knew more of botany than was usual for a zoölogist; and Gray, then a young and rising botanist, was very solicitous to please Agassiz. Their friendship grew rapidly, until completely checked by the publication of Darwin's "Origin of Species," in 1859.

Philadelphia greatly attracted Agassiz. There he met

Dr. Samuel Morton, the great anthropologist, and an excellent palæontologist; a remarkable man, entirely to the taste of Agassiz, through the variety of his knowledge and the originality of his discoveries and thought. He also saw Conrad, Lea, Hallowell, Booth, and Frazer, and was, on the whole, well impressed by Philadelphian savants.

At Washington he was surprised by the gigantic scale on which the French engineer, Major Lenfant, had laid out the capital of the United States, by the imposing and beautiful Capitol, and also by the emptiness of many streets and quarters where building had hardly begun. It was, as it was called then, the "City of Magnificent Distances." Washington was not then the great and beautiful city of the present day. The inhabitants were few; and the government buildings, except the splendid Capitol, were limited to the White House, the State Department, the War and Navy buildings, and the Patent Office. The Smithsonian Institution existed only on paper;[1] and the savants were few in number, while the most prominent one, Professor Bache, the already celebrated director of the Coast Survey, was absent on duty. Arriving fresh from the great capital of France, it was a contrast to find science occupying so small a place in the great American republic, at least officially. Mr. Francis Markoe, the chief clerk of the State Department, and secretary of the National Institute, gave him a set of the Transactions of that society; and to the astonish-

[1] Professor Joseph Henry was not appointed secretary of the Smithsonian Institution until several months later, on the 3d of December, 1846.

ment of Agassiz, the three or four small paper-covered parts were far less important in regard to the quality, and even the number of original papers, than his "Bulletin de la Société d'Histoire Naturelle de Neuchâtel," issued in a very small town of one of the smallest cantons of Switzerland. The disappointment to one who, a few months before, under the dome of the Mazarin Palace, had received a Monthyon prize of physiology from the Royal Institute of France, may be easily understood. As a compensation, Markoe took Agassiz to the rooms of the Institute, and showed him the large and important collections made by Captain Wilkes during his scientific expedition round the world, from 1838 to 1842. He was more especially impressed by the extraordinarily beautiful and exact drawings of fishes, reptiles, molluscs, and corals, executed from life during the expedition by Mr. Drayton, by far the best artist of natural history objects in America.

Until this time, all exploring expeditions into the interior of the United States, sent at the expense of government, from the journeys of Lewis and Clarke, Pike, Major Long, Nicolet, Featherstonhaugh, D. D. Owen, to those of Captain Fremont, had had their reports rather meagrely published in regard to plates and natural history drawings. Congress always voted liberal sums to defray the expense of these publications, but they were at that time all done by contract, falling as spoils into the hands of politicians; and the result was the issue of reports disgraceful as regards material execution — bad type, bad drawings, bad paper — a state of things most discouraging to all

the explorers and savants connected with the government.

In order to remedy such a condition, all the reports of the Wilkes Exploring Expedition were placed under the direction of one man, Mr. Drayton, who superintended the whole publication. But, going from one extreme to another, the Senate, which made the law, inserted in it a provision by which the number of copies of each volume was limited to two hundred, and distributed exclusively to senators; while of Captain Fremont's report, issued in 1845, ten thousand extra copies were printed for the use of the members of Congress. The immense difference between two hundred and ten thousand copies is evident. The result was that Wilkes's reports, being placed exclusively in the hands of senators, no one of whom was a scientific man, or had sufficient knowledge of natural history to appreciate their value but distributed them simply on account of the beautiful plates, became extremely rare from the very first. Half of the number of copies was soon entirely lost, and some of the reports were destroyed in a fire at the printing establishment, so that now several of the great quarto volumes and folio atlases of the expedition have become so scarce that it is almost impossible to get copies at any price.

The report of Fremont, which was defective only in good execution, was furnished with poor engravings, poor plates of fossils, poor paper, and printed from indifferent type. When Agassiz received at Washington, from the hands of Colonel Abert, chief of Topographic Engineers, Fremont's report and those of Nicolet, Abert's

son, D. D. Owen, and Featherstonhaugh, he immediately saw that a great reform was needed to give their true value to all these government reports and publications. On the one hand, Wilkes's report was lost to the scientific public by its scarcity and the mode of distribution; and, on the other hand, Fremont's report and others of the same sort were so badly executed that they were a disgrace to the country.

From this moment Agassiz began to urge constantly on those in power at Washington the necessity laid upon the United States government to publish only well-executed volumes, especially in regard to plates of natural history and landscape drawings. He himself set the example in 1850 in publishing his important exploration of Lake Superior. His efforts, combined with the powerful help of Professor Bache and of Professor Henry, succeeded in bringing about a much better state of things after 1853, as we shall see. But it was during his first visit to Washington, in 1846, that he laid the foundation for the improvement of the government scientific publications.

As soon as Agassiz was back in Boston, he again devoted himself to his practice of learning English phrases by heart, and speaking aloud in English in his room in order to be able to deliver his first course of lectures before the Lowell Institute. The subject was "The Plan of the Creation, especially in the Animal Kingdom." It is not surprising that he was much concerned about his first lecture at the beginning of December; for it was not an easy task to set forth, in a language which he had never before used in public, one

of the most difficult and complicated questions of natural history, but he was so full of his subject that he trusted to his power to enrapture his very large audience of fifteen hundred persons of both sexes and of all ages. Sometimes words were not at his command, and he would pause and wait patiently, with his peculiar smile and beaming eyes, so characteristic of the man, in the meantime amusing his audience by drawing on the blackboard excellent outlines of animals. His French accent was considered a new charm added to his other personal accomplishments; and he stepped down from the platform in a burst of applause, which plainly showed that he had succeeded in his rather hazardous undertaking.

Until then he had never seen a scientific lecture delivered before so many people. The largest audiences he had seen were in Paris at the lecture-rooms of the Collége de France and the Jardin des Plantes, when George Cuvier was the lecturer, and at the Astronomical Observatory, when François Arago was explaining the "Systême du Monde" before such listeners as Alexander von Humboldt, Biot, Leverier, and a whole crowd of members of the French Institute. In those days three or four hundred persons at most crowded the Paris lecture-rooms, but the fifteen hundred auditors of the Lowell Institute room surpassed everything he had ever thought of. Making a large allowance for the curiosity which attracted many persons, there remained enough to satisfy, and even more than satisfy, his most sanguine expectations. For the first time he understood that very characteristic feature of American

life, — public lectures. He was impressed by the seriousness of his listeners, although he knew well that only a small part of the audience was able to understand the full meaning of what he said; but it was very encouraging to see so many ladies and gentlemen of the world ignorant, almost all of them, of the first elements of natural history, listening attentively to what he had to say. It showed a desire to learn, or at least to be instructed on points in regard to which very few of them before entering the lecture-room had the least knowledge. It was a revelation to him, which from that day caused a great change not only in his scientific life, but also in his social and family habits.

It is fortunate for the progress of science, to which Agassiz contributed so largely during his twenty years of work in Europe, that he did not begin his scientific life in America, for his extraordinary ability as a teacher would have absorbed all his time. To be sure, he would have popularized natural history, by a constant contact, of forty-five years' duration, with the general mass of the American people; but he would never have undertaken his "Poissons fossiles," and many other of his original works. Although his first course of lectures in America, at the Lowell Institute, was a success, Agassiz felt that a part of his power was paralyzed, in a great degree, by the difficulty he experienced in using the English language. For a man who was a good scholar in Latin, in Greek, in French, and in German, it was painful to realize how incorrect his English was, and it was a great regret to him not to be

able to display all his resources and his unequalled talent as a teacher "hors ligne."

His friends in Boston and Cambridge understood this feeling, and, at their request, Agassiz delivered, before a select audience, a series of lectures on "Les glaciers et l'époque glaciaire," in French, his native language. At that time, the number of persons in Boston and Cambridge who knew enough French to follow a lecture in that language was limited. However, the subscription list was large, the ladies outnumbering the gentlemen, and according to his own account it was the best course of lectures he ever delivered. The subject was entirely new in America; the illustrations were excellent and most attractive for the time, and the delivery in correct and even elegant French. It was a rare treat to every one, from the lecturer himself to almost all his listeners, the most enthusiastic being the ladies, who were lost in admiration of the Alpine glaciers, Alpine peaks, Jura boulders, "roches moutonnées," and "cailloux striés," and, indeed, of the Professor.

After these two courses of lectures, Agassiz became a great favourite in Boston society, and he remained such until the end of his life. He had conquered the "élite" of Boston and Cambridge, as well as the common people, not only of Boston, but of Massachusetts and even of New England; for his lectures were published at once, and almost *in extenso* in newspapers.

During the delivery of his Boston lectures, his favourite pupil at Neuchâtel, Frank de Pourtalès, had joined him, the first of Agassiz's European scientific friends to

come to this country, attracted by his glowing accounts in his private letters from America. The addition of Pourtalès, who had independent means, was important, for Agassiz did not have to provide for his support, and he was greatly assisted by him, when he settled at East Boston.

After repeating his Lowell lectures at Albany, before a very sympathetic audience, Agassiz and Pourtalès embarked at New York for Charleston, South Carolina. The reception they received was particularly gratifying. Everything possessed a charm unknown to Agassiz until then, and it was the first time that he came in contact with a sub-tropical fauna and flora. Besides, the broad and generous hospitality of the planters attracted him much, and Agassiz and Pourtalès were both glad to meet gentlemen, coming from their common stock of French and Swiss Protestants, like de Saussure, Ravenel, and others, or Dr. Fabre, an old Swabe student of the University of Tübingen. But the man who particularly pleased them was Dr. Holbrook, a herpetologist of talent, one of the rare zoölogists of the New World, and at the same time a most amiable and serviceable man.

Agassiz delivered a course of lectures, with the same success as before the Lowell Institute, which made him at once a great favourite in Southern society. Established with Pourtalès on one of the islands near Charleston, he was in perfect ecstasy over his daily discoveries of new fishes, new turtles, new molluscs. The rich entomological fauna was also a constant surprise. But what made the greatest impression on him as a natu-

ralist was his contact with a large population of negroes. With his power of comparing zoölogical characters, it was impossible for him to consider the black man as a species identical with the white man. To one who considered not only the species, but even the genus, as natural divisions, whatever the system of classification adopted, the conclusion was irresistible.

One of his last lectures, just before leaving Neuchâtel, was on the geographical distribution of animals ("Notice sur la géographie des animaux," "Revue Suisse," avril, 1845), in which he had insisted that every animal and plant is confined to a certain portion of the earth, while man is the only one which covers the whole surface. As he says, "L'homme, malgré la diversité de ses races, constitue une seule et même espèce sur toute la surface du globe." It was hard for him to abandon this view; but he was too thorough a naturalist, and had a too exalted idea of the immutability of species, like his master, Cuvier, to believe in only races for man. After his first visit to South Carolina, species, in his eyes, existed for man as well as for every other genus. That is to say that the genus *homo* is composed of several species; for instance, the Caucasian or white man is one species, with many varieties or races, such as the Arabs, Indians, Turks, Scandinavians, Irish, Slavic, Greeks, Italians, etc. The negro is another species with many races or varieties, such as the Hottentots, the Soudans, the Congos, the Zambesi, etc. But it would be erroneous to conclude, from his opinion as a naturalist, that he was in favour of slavery. This was an abyss which he never crossed. The pas-

sionate and bitter discussions, which already agitated and divided the South from the North, had no influence on him, and he never took part in them, directly or indirectly. It is true that several politicians of the time made use of his opinions for their own selfish interests, but it was impossible for Agassiz to prevent it. Confining himself to a zoölogical point of view, he admitted with great sincerity and frankness, that although once a believer in the unity of the races of man, he had found out that this was an error, and that his studies among large numbers of negroes and Indians had led him, as a zoölogist, to conclude that it was impossible to consider them as simple varieties or races of the white man. In his view, they were entirely distinct species, each, — negroes, American Indians, and Circassians or Europeans, — possessing its peculiar varieties or races.

But as regards the servitude of one species to another, and the right of one man to sell another, Agassiz never, for an instant, justified such a proceeding, either morally, socially, or religiously. Science had nothing to do with such an iniquity; to deal with it was the work of morality, philanthropy, politics, and religion, but not of a savant, whose domain is entirely outside of all institutions of society.

In early spring Agassiz returned to New York, where he met his assistants, Edward Desor and Charles Girard, who had left Paris in February, and had embarked on a sailing-ship at Havre, the 2d of March, 1847. It now became needful to have a permanent establishment somewhere; and Agassiz did not hesitate to choose Boston as his headquarters, on account of the great

interest and sympathy shown to him since the day of his arrival on American soil; and, curiously enough, the house he leased was only a stone's throw from his landing-place at the Cunard wharf.

Accompanied by Pourtalès, Desor, and Girard, he came to Boston, early in April, stopping at a boarding-house in Temple Place, preparatory to arranging for a house. Agassiz took, for one year, a three-storied brick house at East Boston, close by the sea, the tide even entering the garden; where he tied up a little row-boat, called, in New England, a dory, as his first contribution to the furniture of his establishment. Here is another example of atavism, in a descendant of the lake-dwelling peoples of Switzerland, who were always ready to return to water, whenever occasion offered. He was led to the choice of this house, with its rather heavy rent, — one thousand dollars a year, — by his ardent desire to have a laboratory close by the sea, where he could get marine animals to his heart's content, and preserve them alive.

It was not easy for four Europeans, three of whom spoke hardly a word of English, to furnish a house, and remove there all their property, including books, large diagrams, and the several barrels and boxes of natural history specimens collected since Agassiz's arrival.

Before the final arrangement and the removal to East Boston, the health of Agassiz broke down, for the first time in his life. Until then fatigue and anxiety of all sorts had made no impression on his strong constitution; he seemed to be above the reach of sickness. But

the numerous exertions on many lines entirely different from those to which he was accustomed; the American way of living, so new to him, added to his great anxiety as to his future, which was still uncertain; all this fell heavily upon him; and it is not surprising that a few days after his return to Boston he was seized by a severe attack of nervous prostration, a malady which clung to him from this time to the end of his life, recurring now and then, with an increase in the frequency of its attacks as he grew older, and as he constantly and often imprudently burdened himself with new duties.

By the end of May the settlement was achieved; rooms were assigned for microscopical studies, for the dissection of animals, for the drawing of large diagrams for public lectures, and the collections were sorted and divided for future distribution. Every day Pourtalès and Charles Girard went sailing in Boston harbour, dredging the bottom for specimens; or they followed on foot the edge of the tide water on beautiful Chelsea beach, picking up every animal worth preserving.

The originality of this naturalist-home brought to East Boston not only all those engaged in the study of natural history, but also many ladies and gentlemen curious to see how practical zoölogy could be made. Agassiz, with his usual buoyancy of spirit, and his ever-ready desire to teach, showed the ladies how to look into the microscope, explaining graphically the wonders of each small animal. Then, turning to the tank of salt water always teeming with marine animals, he would take a fish, or a big jellyfish and explain its way of swimming, or its system of blood circulation. Time

passed quickly, and his visitors left him charmed with what they had heard and seen. Boston felt proud of the acquisition of a naturalist of genius, while Agassiz was delighted to have excited an interest among persons so intelligent and refined in taste.

During the heat of summer, Mr. Lowell, always attentive to the comfort and welfare of Agassiz, invited him and his assistant, Desor, as his guests, to visit Niagara Falls and the great rapids of the St. Lawrence River. The impression of this grand and picturesque region, combined with the finding of glacial scratches everywhere, and the sight of many zoölogical specimens, especially fishes, created in Agassiz an admiration and an enthusiasm difficult for any one not a naturalist to realize, and from that moment he was resolute to consecrate the remainder of his life to the study of the natural history of the New World.

Returning to Boston, he received an invitation from Professor Bache to join in a cruise along the shores of Cape Cod and the island of Nantucket, on the coast-survey steamer *Bibb*, commanded by Lieutenant (afterward Admiral) Charles Henry Davis, U. S. Navy, who was then employed in surveying the bay of Boston,—an excursion which passed for Agassiz like a dream of the Thousand and One Nights. In one day, as he says, he learned more than in months from books or dried specimens. It was a new opening for his never-ending activity of spirits and schemes. A most intimate friendship grew up with both Professor Bache and Lieutenant Davis from that first cruise, and lasted as long as they lived, and in them Agassiz found, not only sympathizers,

but true patrons of scientific researches, happy in the opportunity to secure to America the services of such a savant. There is no doubt that Agassiz's settlement in America was due to the kind reception and many acts of true friendship and admiration he received from Mr. Lowell and Professor Bache.

Before his first year in America was over, a most intimate friend of his Swiss family, M. Charles Louis Philippe Christinat, arrived at his house in East Boston. Victim of a political revolution in the Canton de Vaud, Christinat, for many years a minister in the village of Montpreveyres, was obliged to leave his parish, and after wandering as an exile in Italy and France, he resolved to join his friend Agassiz, and finish his life with him. He possessed the full confidence of Agassiz's mother, and the family was very glad that such a trusty friend was willing to help Agassiz by his advice and his devotion to his person and interests; for they all knew how much Agassiz was influenced, and often not in the right direction, by his secretary Desor.

As soon as Christinat arrived, at the end of September, 1847, Agassiz, who remembered how devoted Christinat had always been to him since his childhood, going so far as to supply his always empty pocket with money in order that he might make his much-desired journey to Paris, felt that he had at last near him a man whom he could fully trust. It was a great relief to his mind. His relations with Desor were no longer as friendly as they had formerly been at Neuchâtel. When they met again in April, after an eight months' separation, Agassiz saw at once a great change in Desor's manner, and more

especially in his way of talking. He had left him in Paris his secretary and assistant, and he found him at New York his associate and collaborator, with a certain air of domination which extended even to every act of his private life. Passionate and painful discussions followed one another in rapid succession; and although they all ended in reconciliation, they were but the beginning of most serious difficulties. It was evident that Desor's prolonged sojourn at Paris, during which he had assumed the joint authorship of one of Agassiz's publications, and his journey in Scandinavia — at the expense of Agassiz, who found the amount of one thousand dollars a little hard to pay back to his banker in his already straitened pecuniary position — had given him a somewhat exalted opinion of his scientific and social value. Agassiz was much hurt by this new demeanour of his secretary; it was hard for him to be lectured by his own pupil both on scientific and private affairs. He recalled the poor young man who came to him at Neuchâtel at the end of 1837, not as a naturalist of worth, but only as an amanuensis and translator, and at whose mercy now, ten years later, he found himself, both scientifically and socially. As he himself said, it was he who brought the water to turn the mill, for Desor had never contributed a cent to the constantly increasing expenses.

The following letters are presented to show how Agassiz was always ready to help and encourage a young naturalist; and they allow me, at the same time, to define my position with him. Being an assistant at the Jardin des Plantes, under the direction of M. Cordier,

the professor of geology, I was offered, as a reward for work done in determining invertebrate fossils at the Museum, a journey of three years' duration, outside of Europe, with my own choice as regarded the country to be explored. My acquaintance with Agassiz led me to choose North America, and I wrote him asking if he would help me by his advice, and tell me his plans for explorations during 1848. His answer follows: —

BOSTON, 30 septembre, 1847.

MONSIEUR JULES MARCOU,
Paris.

Mon cher monsieur, — Ne pouvant écrire aujourd'hui à M. Cordier, ni vous donner de quelques semaines une esquisse arrêté de mes projets de voyage pour l'année prochaine et ne voulant cependant pas vous laisser attendre une réponse à la demande que vous m'adressez de venir rejoindre aux États-Unis, le trio de travailleurs que vous avez connu à Paris, je me bornerai pour le moment à vous dire en termes généraux que je serai charmé de vous associer à ce que je puis faire dans ce pays. Je sais trop bien tout ce qu'il reste à faire dans tous les domaines de la science pour redouter le concours d'efforts combinés dans un même but ; bien au contraire je crois que les résultats scientifiques, que notre petite troupe pourra obtenir seront d'autant plus considérables qu'elle s'associera un plus grand nombre de bons observateurs ; et comme je n'ai aucun penchant à m'approprier les observations d'autrui, vous pouvez être assuré d'avance que quelqu'importantes ou quelqu'insignifiantes que puissent être les découvertes que vous ferez dans ces pérégrinations communes, elles vous seront bien duement acquises, et vous resteront en plein et sans partage, même dans le cas où elles auraient été amenées par des recherches que j'aurais pu vous suggérer. C'est sur de telles bases seulement que je conçois des rapports durables entre hommes dévoués à la science.

Quant à mes projets prochains, j'ai l'intention de visiter cet hiver les Carolines et de revenir pour le mois de février à Boston, pour

me préparer à une course dans l'Ouest. Je désire consacrer une bonne partie de l'été à l'exploration des bords du Lac Supérieur et de la vallée du Mississippi, comme préparation à une seconde course au-delà de ce fleuve, dans la direction des Montagnes Rocheuses. Les ressources dont je pourrai disposer ne me permettent pas de songer à passer l'hiver dans une sorte d'inaction, loin des grandes villes, où je puis par quelques leçons acquérir de quoi poursuivre mes recherches. Je crois de plus qu'il est plus avantageux de couper ainsi en deux temps une exploration de l'Ouest dont la première campagne servira de reconnaissance et de point de départ pour la seconde. Puis il y a dans l'état de l'Ohio plusieurs collections qui méritent d'être étudiées et dont l'examen nous évitera des travaux inutiles, et nous fournira des points de repair. Même ici à Boston, mais surtout à Albany, vous pourriez consacrer bien des mois utilement à vous préparer, car il vous sera difficile, malgré les publications des géologues de New York, de vous faire une juste idée de l'étendue des travaux, en grande partie inédits, qui ont été faits dans ces contrées. Dans ce moment deux caravanes de géologues explorent les états de Michigan et de Wisconsin. Aussi plutôt vous pourrez venir et mieux, et surtout ayez à votre disposition des ressources pécuniaires suffisantes, car pour la dépense les dollars sont à peu près pour nous ce que les francs étaient à Paris, avec un genre de vie qui est à peu près le même.

Ces renseignements préliminaires vous permettront de faire vos préparatifs sans délai ; dès que je le pourrai, je vous écrirai d'une manière plus précise à quoi je compte m'arrêter définitivement pour l'année prochaine, et j'écrirai en outre à M. Cordier pour l'assurer que les intérêts du Muséum ne courront aucun risque si vous venez me joindre. Je n'en veux de meilleure preuve que le fait que j'ai déjà mis spontanément de côté une assez jolie collection de fossiles paléozoiques que je destine au Jardin des Plantes et qui seraient déjà partis pour l'Europe n'était l'ennui de l'emballage.

Je vous remercie de tous les soins que vous avez mis à l'impression des Echinodermes (Catalogue raisonné) et à la rédaction d'un registre de la distribution géologique, addenda, etc. ; ce sont des additions qui seront très utiles, je pense.

Adieu, mon cher Monsieur ; croyez à la sincérité de l'intérêt que

je vous porte et que votre zèle pour la géologie justifie si complétement.

Votre dévoué,

Ls. Agassiz.

In another letter, dated New York, 14 November, 1847, he says: —

Desor est resté à Boston pour le moment; Charles, dont je suis assez content, est ici avec moi; Pourtalès m'accompagne dans le Sud avec mon dessinateur. Nous ferons de la bonne besogne, je crois, et malgré la difficulté de gagner ma vie en faisant des cours depuis que je suis au terme de mes subsides de Berlin, tout va son train, comme devant, et je suis loin de songer à réduire l'étendue de mes recherches pour peu que je puisse continuer à suffire à toute cette dépense à force de travail. Adieu, mon cher ami, venez bien vite et je crois que vous serez content de ce pays.

Tout à vous,

Ls. Agassiz.

END OF VOLUME I.

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LIFE, LETTERS, AND WORKS OF LOUIS AGASSIZ

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LIFE, LETTERS, AND WORKS

OF

LOUIS AGASSIZ

BY

JULES MARCOU

WITH ILLUSTRATIONS

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CHAPTER XIII.

1847 (*continued*)–1849.

AGASSIZ'S VISITS TO THE MARKETS — HIS FIRST TWO STORAGE PLACES, OR MUSEUMS, IN AMERICA — LECTURES BEFORE THE FACULTY OF THE COLLEGE OF PHYSICIANS AND SURGEONS OF NEW YORK — A CALL FROM HIS OLD ARTIST, JACQUES BURKHARDT — SECOND COURSE OF LECTURES AT THE LOWELL INSTITUTE — OFFER AND ACCEPTANCE OF A PROFESSORSHIP AT HARVARD COLLEGE — HIS REMOVAL FROM EAST BOSTON TO OXFORD STREET, IN CAMBRIDGE — DISMISSAL OF HIS SECRETARY, E. DESOR — TRIAL BEFORE THE CIRCUIT COURT OF MASSACHUSETTS OF THE CASE OF E. DESOR VERSUS ADMIRAL CHARLES H. DAVIS — AGASSIZ'S JOURNEY TO LAKE SUPERIOR, AND HIS VOLUME, "LAKE SUPERIOR" — DEATH OF HIS FIRST WIFE — THE SECOND "HÔTEL DES NEUCHÂTELOIS," AT CAMBRIDGE — AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCES.

AGASSIZ was a constant visitor to the great markets at Boston, purchasing all the fishes, crustacea, or wild game he could find; and he was soon a great favourite with all the market-men. What astonished them most was his never satisfied desire for more specimens. He would collect ten, twenty, and fifty specimens of the same species of fishes, and turtles by the hundreds.

At each city where he stopped he never failed to go to the market and carefully examine the stands of fishermen and poulterers. At New York, with the help of his cousin, M. Auguste Mayor, in a few days,

he filled a large barrel with specimens. Charleston's market, even more than the Boston and New York markets, contributed largely to his collections, and specimens accumulated rapidly. Barrel after barrel was filled to its utmost capacity; and Pourtalès and Girard had enough to do to keep pace with the professor's well-known propensity to get hold of every object of natural history with which he came in contact. The collections were at first placed in the upper story, or attic, of Tremont Temple, at Boston; but during the summer of 1847, they were divided into four parts: one of which was sent to Berlin; a second, to Neuchâtel; a third, to Paris; while the fourth was kept by Agassiz, and transferred to his house at East Boston, opposite Bird's Island, or placed in a wooden shed in the garden, where several tanks containing living animals constituted the aquatic laboratory.

At the request of the Faculty of the College of Physicians and Surgeons, of New York, Agassiz delivered in the hall of that institution, during the months of October and November, 1847, a series of twelve lectures, the full reports of which, as given in the columns of the "New York Tribune," widely attracted the attention of the American public. It was the first time that Agassiz's lectures were reported by stenographers, and printed in full, immediately after their delivery, and he was amused by hearing the newsboys in the streets of New York crying at the top of their voices, "Professor's Agassiz Lecture!" The demand for the papers containing these admirable discourses was so great, that the editor of the "Tribune" was

obliged to issue them in the form of a pamphlet, under the title, "An Introduction to the Study of Natural History. Also, a Biographical Notice of the Author" (New York, Dec. 10, 1847; Greeley & McElrath, Tribune Buildings).

His large and attentive audiences were so pleased that the medical students and the New York doctors, headed by the ornithologist, Dr. Trudeau, a special friend of Agassiz, raised a subscription, which filled a large box with silver dollars, and came in a body to Dr. Trudeau's house, where Agassiz was a guest, to present the offering to the professor, as a contribution, they said, toward the payment of the debts contracted on account of his magnificent work on the "Poissons fossiles." Agassiz was much touched, and tears sprang to his eyes, when, turning toward Dr. Trudeau, who made the presentation, he thanked the physicians, surgeons, and medical students of the great city of New York for their very welcome and generous gift.

At the end of one of these lectures Agassiz received a visit, which was to him a complete and agreeable surprise, from Jacques Burkhardt, of Neuchâtel, a "salle d'armes" acquaintance as far back as his student life at Munich. After a rather uncertain life as an artist in Rome, Burkhardt had returned to Neuchâtel just at the time that Agassiz was appointed professor; and as Agassiz was always in want of artists, notwithstanding that he already had two — Dinkel and Weber — in his service, he often employed Burkhardt to draw fishes, and even took him, in 1842, to the

"Hôtel des Neuchâtelois," on the glacier of the Aar. Unsuccessful as a painter, notwithstanding the good teaching and advice of the two great Neuchâtel artists, — the brothers, Leopold and Aurel Robert, — Burkhardt, who was not an exact draughtsman, being skilful only in colouring the drawings after they had been made by others, led at Neuchâtel a precarious and unsettled life, and was unable to make both ends meet.

Disappointed in his endeavour to become an artist of repute, Burkhardt enlisted in a sort of half-military, half-colonial organization, created by the Belgian government as a means of establishing a colony in the district of St. Thomas, in Guatemala. When on the point of sailing, the Belgian government received a very strong protest from the president of the republic of Guatemala, against the sending of any military organization; which he declared would not be accepted under any pretext. This put an end to the scheme, and left Belgium much embarrassed by the crowd of adventurers who had gathered; and in order to dispose of them in the best manner possible, they were ordered to embark on a ship at Antwerp, with sealed orders, to be opened by the captain of the ship and the head of the expedition, when at a distance of several hundred miles from the Belgian port. The sealed orders directed the vessel to go to New York, and there to disembark the colonists, who were to be marched off to the Belgian consulate, and receive two months' pay, after which they were to be disbanded, and to go and do what they pleased.

Thus Burkhardt found himself in the streets of New York, ignorant of English, with only a small sum of

money in his pocket, and without an acquaintance. He was, however, soon helped by a Neuchâtel merchant, established at New York, — M. Diacon, — and succeeded in making a humble living by drawing pictures on shades, and washing and mending old oil paintings.

Agassiz was in complete ignorance of what had become of Burkhardt since he left the glacier of the Aar and Neuchâtel in 1843. But Burkhardt, learning through the newspapers that Agassiz was delivering a course of lectures, gladly called on him and told his pathetic history, his attitude and appearance amply proving that life in the streets of New York under such conditions was a difficult one to endure. Agassiz, always open-handed and generous, received his old artist with great kindness, and offered him a home, on the single condition that he should draw his zoölogical specimens. The unfortunate artist was only too ready to accept any offer, or, more correctly, any arrangement, which promised a living; and with that lack of specific agreement which always characterized Agassiz's connection with his assistants, he resumed his position as draughtsman, and was brought by Agassiz to East Boston, on his return from New York, at the end of November, 1847. This hap-hazard association lasted until the death of Burkhardt, and is the only one, of all those formed in the same way, during the life of Agassiz, which remained undisturbed.

As soon as he had returned to Boston, Agassiz delivered another course of lectures before the Lowell Institute. His success increased with his facility in the use of English. He had entirely conquered Ameri-

can audiences, and his popularity grew at a pace which much astonished him. One day in January, 1848, he was approached by some of his friends, — among them most particularly Mr. John A. Lowell, — to know if a permanent professorship at Harvard College would be acceptable. His answer at first was a little hesitating; but the breaking out of the French Revolution in February, 1848, and the consequent great commotion all over the continent of Europe, including a revolution at Neuchâtel and rioting in Berlin, removed all his doubts; and he accepted the chair of zoölogy and geology, established specially for him by Mr. Abbott Lawrence, a Boston gentleman, who at this time founded the Lawrence Scientific School, in direct connection with Harvard University.

Never was a more happy appointment made at Harvard; it was a red letter day for the old university; for not only did Agassiz bring with him his unique reputation as a great naturalist, but his example of originating and urging forward new projects soon revolutionized the whole institution. Indeed, no one did so much to prepare for the new era of prosperity, and to increase the facilities of instruction, now so successfully organized and maintained under the presidency of Dr. Charles W. Eliot. But further, his children have since become the greatest patrons and benefactors of the university; for, taken altogether, they have already given not far from one million dollars, — the largest amount received from one family.

After his acceptance of the Harvard professorship, Agassiz, with Pourtalès, sailed for Charleston, South

Carolina, delivering there another course of lectures and continuing to collect specimens and make observations on the fauna.

The ease with which money could be made by public lectures rapidly turned the heads of Agassiz and all his household. His secretary Desor sent money to a German cousin, a gardener, asking him to come over at once, which he accordingly did. Then Desor arranged to have a regular emigration of assistants and attendants of all sorts from Neuchâtel to Cambridge, in order to make a permanent and large establishment. In this way an excellent lithographer, A. Sonrel, with the complete equipment of a designer and a printer, was secured. It was also decided to remove Agassiz's great library, and an order to pack up and to accompany it to America was sent to the librarian in charge, Henri Hüber; and finally two Swiss servants were also sent for.

During the absence of Agassiz in South Carolina, Desor, with the help of Dr. A. A. Gould, the learned conchologist of Boston, worked at a text-book of zoölogy, and as the book was to be printed in English, and as soon as possible, Desor lost no time in increasing his incomplete knowledge of English.

Before leaving for Charleston, Agassiz had rented a wooden house just built at Cambridge, the third house on the right side of Oxford Street, near the university; a much smaller house than the one at East Boston, and cheaper, costing only four hundred dollars a year; while the university had also secured for Agassiz's laboratory a small old bath-house close by Charles River, for the

storage of his collections and microscopical and anatomical studies. The removal was mainly effected during April by Pourtalès and Girard, who brought in a dory all the specimens from the East Boston house, and stored them partly in the cellar of Harvard Hall, partly in the old bath-house near the Charles River, and partly in the cellar of the Oxford Street house; and when Agassiz returned from the South the 4th of April, 1848, he settled at once at Cambridge. Under some pretext Desor had remained at the house at East Boston, and it was even determined to keep that house a year longer, in order to use it for the reception of all the assistants and friends expected to arrive soon from Switzerland, the Cambridge house being too small to admit of such an increase of inhabitants. John A. Lowell was frightened when Agassiz told him of what he proposed to do, and it was with some difficulty that he at last persuaded Agassiz to abandon the scheme, as too expensive and entirely disproportionate to his pecuniary resources.

We have now arrived at the most critical moment in the life of Agassiz. Different publications in French and in German made by Desor and Karl Vogt are so one-sided and ill-natured in their tone, that an exact history of the whole affair is here an absolute necessity. The continual painful discussions, on scientific and domestic subjects, between Agassiz and his secretary Desor increased to such an extent that Agassiz's best friends on this side of the Atlantic, Messrs. Mayor and Christinat, advised a separation.

Having just arrived at New York, at the beginning of May, 1848, I received, through A. Mayor, an urgent invitation from Agassiz, to visit him and spend a few weeks at his house in Cambridge, preparatory to an extensive tour in his company to Lake Superior. I had been only a few days at Cambridge when I found myself involved in the turmoil of the personal difficulties between Agassiz and his secretary. The first who spoke to me of the matter was Desor, who endeavoured to prejudice me against Agassiz, and succeeded to a certain extent. However, from the start it did not please me that a man who, ten years before, had come to Neuchâtel, unknown and without means, should speak so harshly and so inconsiderately of the person who had received him more than kindly, had made him an inmate of his household, given him every opportunity to rise in the world, and even taught him natural history. Agassiz saw at once that I was influenced to some extent by his secretary, and invited me to a private talk. There he unburdened his heart, sometimes sobbing and crying like a child. It was extremely painful to him to be so ill-treated by one who owed everything to him, although he was much attached to Desor, whose qualities as a secretary and assistant were highly praised and valued by him. At the end of our long talk, Agassiz declared that he would have no further connection of any sort with Desor, and begged me, as the greatest favour he had ever asked any one, to go to East Boston and tell Desor

that all relations between them were at an end, and request him to vacate the house by the first of June, when the lease would expire. I declined to give an answer at once, saying that in twenty-four hours I would make a reply.

My first impulse was to be out of the way, for I was very much frightened by the responsibility and the awkward position in which I was placed. Knowing no one but the inmates of Agassiz's household, I asked advice from every one of them. All denied Desor's accusations as untrue, and all disapproved his conduct towards Agassiz. Christinat, who I knew represented the mother of Agassiz, took me aside and insisted in the most positive terms on their complete separation. He would not allow compromise of any sort; and he insisted more especially on the immovable determination of Agassiz's mother, not to permit one of Agassiz's children to join him in America, so long as Desor remained in the house. This part of the information derived from Christinat was decisive for me. However, I wanted Agassiz's own words in regard to his children; for Desor had repeatedly said in my presence that Agassiz did not care anything about them. Agassiz was in much distress when he heard the accusation, and there was the most pitiful scene imaginable. This idea of not seeing his children around him again was so terrible that he almost fainted away. Next day, after a sleepless night, my decision was made; I had chosen to side with the father, wife, and children against the adventurer, introduced in a fatal moment into the Agassiz household; and I told Agassiz that I accepted his mission, however

disagreeable it might be, but that I wished to be accompanied by Frank de Pourtalès. The latter consented, and we went directly to the house at East Boston, where I delivered my message. Desor was at first stunned by it, but he soon recovered, and became insolent to such an extent that I withdrew, in company with Pourtalès, and we returned to Cambridge.

There Agassiz, moved to tears, took me by both hands and kissed me in the old Swiss fashion. He was full of thanks and compliments. He felt himself another man, because he had been relieved of a constant burden in his social and even mental life. For little by little Desor had taken such a hold on him, that he was not even free to express all his opinions and views on scientific subjects. In fact, he was controlled by Desor as by a manager, and not always considerately, being too often handled rather rudely. He had to provide all the money, and instead of being thanked for it, he was subjected to all sorts of moral tortures.

Matters took such a turn that friends interfered, and by common consent the whole difficulty was submitted to arbitrators. Agassiz chose John A. Lowell, Desor took Dr. D. Humphreys Storer, and the two elected as umpire Thomas B. Curtis, all of them among the first men in the city of Boston. After a thorough investigation the three arbitrators came unanimously to the opinion that Agassiz had been wronged by Desor, and consequently gave an award entirely in favour of Agassiz.[1]

So ended the scientific, social, and friendly relations between Agassiz and his German secretary, after a con-

[1] See the award, in "Trial of Desor *versus* Davis," pp. 53–56. Boston, Stacy & Richardson, printers, 11 Milk Street. 1852.

tinuance of about ten years, during the last three of which they were often turbulent and even violent.

Desor, after all his accusations against the man who had made him what he was, was bold enough to pretend that he had remained silent, and had only threatened to expose Agassiz; as if he had not attacked him in every way, both verbally and in print. (See "Synopsis des Echinides fossiles," par E. Desor, p. xx. Paris, 1858.)

The intervention of Professor Karl Vogt, an honest, but not always very exact and well-informed man, rather inclined by his eager disposition to see only one side of things, and to turn into ridicule every other view and opinion, has led me to give the real facts of the case, although I pass over many details. How Vogt in his biography of Desor ("Eduard Desor, Lebensbild eines Naturforschers," von Karl Vogt, in Deutsche Bücherei, in Zwanglosen Helten. IV. Serie, Heft 24. Breslau) could have declared that the award was in favour of Desor, it is difficult to understand, except on the supposition that he never saw the paper either in manuscript or printed, and was deceived by some one.

The scheme which he had prepared was an utter failure, happily for the natural history of America. He hoped to oblige Agassiz to leave Cambridge, and even the United States, when he meant to step in and take his place both officially and socially. Desor thought highly of himself, and over-shot his mark. He never was more than a second or third-rate naturalist, at the best, unable to go out of the beaten paths opened to him by Agassiz, Gressly, and Keller. He had no originality whatever, and seemed never

to realize that, after all, he was only small change in comparison with the splendid medal "fleur de coin" of Louis Agassiz. His real value was quickly seen by Mr. John A. Lowell, who did not hesitate to uphold Agassiz, and never invited Desor to deliver a course of lectures at his institute, notwithstanding the pressure brought to bear on him by several friends of Desor, among them the celebrated Unitarian minister, Theodore Parker.

A few words more will dispose of Desor's doings in America. After receiving more than hospitality on board the *Bibb*, — for Lieutenant Charles H. Davis gave him pay as his secretary under the designation of master's mate, — Desor sued Commander Davis in December, 1851, before the Circuit Court of the United States for the district of Massachusetts, for breach of contract to write a memoir on the geological effects of the tidal currents of the ocean.[1] The jury gave a verdict for

[1] In a letter to Desor, dated February, 1849, written after the award between Desor and Agassiz, Davis said, "It appears from the award of the arbitrators, which, as bound to do both by honor and judgment, I fully accept — that in every point in dispute you have done injustice to M. Agassiz, and have misled those of your friends who were influenced by your representations"; and in another letter, dated March, 1849, he adds, "You speak of my condemning you unheard (it was M. Agassiz, if any one, whom I condemned unheard). . . . I have no wish to boast of any favors I may have conferred upon you. Nevertheless, I must say that the cordial and hospitable entertainment you received on board the *Bibb* last summer and autumn and my active but, as it appears, unavailing efforts to bring to a termination the unhealthy excitement under which your mind has labored towards M. Agassiz, may well relieve me from any painful sense of obligation to you." Finally, Admiral Davis wrote to Desor on the 5th of March, 1849: "No one can regret more sincerely than I do that a moral necessity, superior to all other considerations, has been created by yourself, which annuls these agreements" (*i.e.* the investigation of the subject of Ground Ice, the Natural Causes of Fogs on Shoals, and some other scientific topics, besides the Tidal Currents). — "Trial of Desor versus Davis," pp. 62-67, Boston, 1852.

the plaintiff, fixing the indemnity at a thousand dollars. The defendant moved for a new trial; and the case was definitely adjudged by his honour, Peleg Sprague, as follows: "The jury must have made a mistake. The verdict cannot stand in its present form. I shall give the plaintiff his election to remit five hundred dollars, or to take the opinion of another jury." The decision was accepted; and Lieutenant-commander Charles H. Davis was obliged to pay Desor five hundred dollars, besides his hospitality on board the United States steamer *Bibb*, his very generous treatment during Desor's stay, and his many acts of kindness during 1848.

After this performance, Desor, who had remained in America during 1849, 1850, and 1851, constantly causing as much annoyance as possible to his old benefactor and chief, had no alternative but to return to Europe, which he did in March, 1852, publishing, as a last Parthian arrow against Agassiz, his pamphlet, "Trial of the Action of Edward Desor, Plff., *versus* Charles H. Davis, Deft.," etc., Boston, 1852.

We have here a rare example of ingratitude in one who was elevated from nothing to a recognized place in the scientific world, and then turned against the hand which raised him from his obscurity and poverty.

Agassiz's first course of lectures at Harvard University was largely attended, not only by the regular students, but also by law students and several professors and instructors of the college and Scientific School. As soon as it was finished, Agassiz started to explore Lake Superior, accompanied by ten students, two gentlemen

from Boston, three doctors, and myself. The rendezvous was a hotel at Albany, on the 15th of June, 1848. On the same evening, Professor Agassiz began his daily remarks on the region travelled over during the day, giving a sort of itinerary lecture. He had brought with him a piece of black canvas and some chalk, and delivered a regular address, on rocks polished and scratched by old glaciers and erratic pebbles and boulders, transported at a very remote epoch, and called attention to the deposits of the red rocks of the Connecticut valley, as well as to the vegetation of Massachusetts.

It was a very original and unique summer natural history school; for Agassiz never repeated it, although he said emphatically that he would do so every summer. But circumstances were stronger than his desire; and with the exception of a rather limited excursion to the Adirondacks, the Lake Superior expedition remains his only scientific exploration into the interior of North America. To be sure, he made several other explorations on the Atlantic coast, in Maine, the White Hills, Massachusetts, South Carolina, and Florida, and created a summer school at the island of Penekeese, as we shall see; but he never made another scientific tour similar to the Lake Superior excursion of 1848.

The tour extended through Niagara Falls, Lakes Erie and Huron, with researches on the islands of Mackinaw and St. Joseph, at the rapids of Sault Ste. Marie, and on the whole northern shore of Lake Superior. In birch-bark canoes, containing three, four, or even five persons, besides three boatmen each, every feature of the unsafe and sometimes dangerous shores was explored,

with halts at every interesting place, from Gros-Cap at the outlet of Lake Superior to Michipicoten, Pic, and Fort William factories of the Hudson Bay Company. At that time the northern part of Lake Superior was a perfect wilderness, all activity and marks of civilization being confined to Point Keewenaw and its copper mines. During the journey, which lasted from the 30th of June until the 15th of August, only a few Indians, called "gens du Lac" by the French Canadians, a branch of the Ojibwa tribe, were met. The expedition when at Fort William ascended the Kaministiquia River as far as Kakabeka Falls, a distance of twenty-five miles. There it separated; one canoe, the largest, containing five members of the expedition, myself among them, left the main party, and started on the 25th of July to make the round of the lake, returning to Sault Ste. Marie by the south shore, in order to visit some of the celebrated copper mines. Agassiz, with the rest of the party, returned to the entrance of Lake Superior, where he arrived the 15th of August, returning by the same road.

The main results of the exploration were, first, an extension of the glacial theory of Agassiz to include all the shores of Lake Superior, almost an inland sea; second, a thorough knowledge of the fishes of Lake Superior and their comparison with those of the other great Canadian lakes; third, a comparison of the vegetation of the northern shores of Lake Superior with that of the Alps and the Jura Mountains; and fourth, large collections of fishes, reptiles, birds, shells, and insects, rocks, minerals, and fossils.

A remarkable volume entitled "Lake Superior: its Physical Character, Vegetation and Animals, compared with those of Other and Similar Regions," by Louis Agassiz, with a narrative of the tour by J. Elliot Cabot, and contributions by other scientific men, elegantly illustrated, appeared in due time, — March, 1850, — at Boston. A few words are necessary to call attention to the great value of the volume, which marked an epoch in natural history publications in America. Until then, all books containing plates of natural history objects, with a few exceptions, such as Isaac Lea's "Contributions to Geology," Conrad's "Fossil Shells of the Tertiary," "Natural History of New York," and Wilkes's "United States Exploring Expedition," had been executed in very poor style. Compare, for instance, the volumes of General J. C. Fremont, issued in 1845, with that of Captain H. Stansbury, issued in 1852, two years after the appearance of Agassiz's work on Lake Superior, both of which were published at the expense of the government. Stansbury's survey of the Great Salt Lake is in every respect a very creditable publication; while, on the contrary, Fremont's first and second expedition to the Rocky Mountains, Oregon, and Northern California is a disgrace as regards the execution of landscapes and natural history illustrations. Agassiz, who had succeeded in bringing the lithographic establishment of M. A. Sonrel from Neuchâtel to Cambridge, put into the hands of that excellent French artist all the illustrations and drawings of the landscapes and specimens. Everything was done in fine style; and the volume, when published, attracted attention, and even

admiration; the best proof of its great value being the fact that now it commands more than double its original price.

Sad, but not unexpected, news awaited Agassiz on his arrival at Cambridge, on the 28th of August. The death of his wife, at Freiburg-im-Breisgau, Grand Duchy of Baden, had occurred on the 27th of July, 1848, two days before her thirty-ninth birthday. She had learned, with great relief of mind, the separation of Agassiz from his secretary; but she was too ill to hope for recovery, for consumption had set in. After a long struggle she died, surrounded by her three children, in the house of her beloved brother Alexander Braun, professor of botany at the University of Freiburg,[1] and was buried at the old cemetery of that town, closed since 1867, and no longer used for burials. A simple granite gravestone, with only her initial letters, C. A. (Cecile Agassiz), engraved on it, marks her resting-place; no date, no sign, indicates that here reposes

[1] The accomplished daughter of Alexander Braun, Mrs. Cecile Mettenius, says in the life of her father: "After many days of suffering, during which hopes of recovery mingled with presentiments of the approach of death, Mrs. Agassiz died quietly, the 27th of July, 1848. A few days before her death, she received with joy a letter from her husband, to whom she had sent the portraits of her children, drawn during her sickness." It was a last tribute of love. Mrs. Mettenius adds: "She had had a life full of struggles and of sorrows." Braun wrote to his brother (Max Braun), announcing the sad news: "Our sister, who has had so many afflictions, has found to-day her rest after her stormy life. She has suffered much. God will give her in the other life what will change to joy all the suffering of the life on earth; there she will understand the divine Providence which is full of charity, but whose ways are so obscure to us." ("Alexander Braun's Leben," p. 405; Berlin, 1882.)

the first wife of the great naturalist, Louis Agassiz, the mother of his children.

Alexander Braun had removed his family from Carlsruhe to Freiburg, after his appointment as professor of botany at the university; and almost as soon as he was settled there, his sister, Mrs. Agassiz, became so ill, that, after the month of December, 1847, she was unable to leave her bed, except for a few hours each day. Phthisis made rapid progress and became incurable.

Professor Braun kept with him the children of his sister until he heard from Agassiz, who asked him to conduct his two daughters to Switzerland, to their grandmother, where they were to remain until he could himself go for them, or arrange for their joining him in his lately adopted country. The son Alexander, then twelve years old, stayed a year longer in the Braun family. Before separating, the children received the first visit from an American family, Mrs. Bruen and her two daughters, the oldest since so well known as the wife of the celebrated author of "The Italian Sculptors," Charles C. Perkins, of Boston, friends of their father, who came specially to Freiburg, in August, 1848, in order to tell them, *viva voce*, how kindly their father had been received, and how highly he was esteemed in the New World. A few weeks after this visit, Braun took his two nieces, Ida and Pauline, and placed them under the guardianship of their grandmother, Mrs. Agassiz, at Cudrefin, on the lake of Neuchâtel.

The year 1848 was most eventful in the life of Agassiz: first, in his appointment as professor at Cambridge; second, in the dismissal of his secretary, Desor; third,

in the death of his first wife. The first two events proved most beneficial to his future life.

Agassiz found at his house M. Sonrel and his wife, awaiting his return from Lake Superior. A house was immediately leased in the vicinity, and Sonrel began in earnest the establishment of his lithography. During September his two workmen arrived, a draughtsman and a pressman. Then came, in succession, Professor Arnold Guyot, with a nephew and a cousin; Charles Girard's brother and sister; Hüber, with the library and some specimens of rocks and fossils; and M. Leo Lesquereux, with his wife and five children. Every one was lodged, at least, for several days, in Agassiz's Oxford Street house. Mattresses were laid on the floors of different rooms, even in the parlour; the only unoccupied room being the dining-room, where the table was always abundantly furnished. It was a second "Hôtel des Neuchâtelois," transferred from the glaciers of the Aar to Cambridge. In all, there were twenty-three persons, twenty-two of whom came from Neuchâtel, town or canton. Pourtalès and Marcou soon left, but were replaced at the dining-table by the two German assistant chemists of Professor Horsford. In fact, it was "la Maison du Bon Dieu," as the French call it, every one entering any room, and Agassiz receiving with a smile every new arrival.

Some details may be interesting, for it is not likely that such a naturalist household will ever be seen again. "Papa" Christinat, as he was called, was the general manager. More than sixty years of age, he was still extremely active, possessed excellent health,

and was most devoted to the welfare and interest of Agassiz. Although not speaking or understanding more than half a dozen English words, he had the skill to make himself understood, by gestures and pantomime, which he executed with great readiness, and generally with good results. He succeeded in teaching the cook, an illiterate Irish girl, a sufficient number of French words to make her understand his directions in regard to some French dish to his taste. His most remarkable performance was the buying of provisions. Not satisfied with the butcher who brought meat and vegetables to the door every day, he concluded to go himself to the great markets in Boston. Every day, he walked into Boston, starting at daybreak; and, to economize, he carried a great basket on his arm, and so calculated his time, as to arrive at the Cambridge bridge before the toll office on the Cambridge side was open. Then he would stand on the bridge, between the two toll houses, for five, ten, or even twenty minutes, waiting patiently until the toll keeper on the Cambridge side opened his small cabin and office, — an indication that the toll had been paid; and then Christinat would pass in front of the toll house on the Boston side, thus avoiding the toll of one cent!

At the Faneuil Hall and Quincy markets, he always made excellent choice of meat, fowls, fishes, lobsters, and vegetables, for he was truly "a connoisseur"; but he spoke French to all the market men, his only English being *how much?* and he never understood the answer; but paid what he thought was proper. The men almost always remonstrated on the ground that it was not the

price asked for. "C'est assez!" was the invariable answer of M. Christinat, who then triumphantly put the purchase into his basket, marching off as if he were perfectly satisfied. As he was known all over the market as the friend and housekeeper of Professor Agassiz, the traders let him do what he pleased, but marked the difference of price in their books. At dinner, Papa Christinat would say: "Comment trouvez-vous le gigot de mouton? ou le poisson?" "Excellent!" was the ready answer of all the guests; "Eh bien! je ne l'ai payé qu'un dollar et quart," when the piece, according to the market value, may have been two dollars or two dollars and a half. Agassiz used to smile quietly and compliment Christinat on his fine bargain. But, alas! at the end of the month came long bills from the fisherman, the butcher, and provision dealer, which put an end to Christinat's method of purchasing at markets at low prices.

All sorts of specimens in alcohol, and even alive, were constantly coming by express, sent from all parts of New England and even from more distant parts of the country. One day, to the great amazement and amusement of all the inmates of Agassiz's American "Hôtel des Neuchâtelois," the express brought a live big black bear sent from the forests of Maine by an admirer of Agassiz's lectures at the Lowell Institute. There was no other indication on the label attached to the neck of the animal. This time the professor had "caught a Tartar"; he had no place to keep it, and he begged an expressman to keep it in his stable. There, all the horses were made uneasy by such a neighbour, and after a few days the animal was disposed of by poison-

ing, and dissected, his bones being preserved for the collection.

Another day there arrived, on a wagon, a single specimen, so large and weighty, that it was as much as the horse could do to drag the heavy load. It was an enormous sea-turtle, the gigantic leather-back (*Sphargis corriacca*), found cast up on the coast of Cape Cod, after a violent storm. The big animal, an inhabitant of the Caribbean Sea, had lost one of its largest paddles, near his head, cut off close to the carapace, very likely by a shark; and although the wound was well healed, the loss of the paddle incapacitated him for facing a Gulf Stream storm, which carried him far north, until beached on the sand of Cape Cod. He was carried to the old bath-house, where dissection was begun. Christinat, with an eye to economy, noting the beautiful veal-like meat, took some home, and at dinner it was so praised and relished, that for a week the numerous guests of the "Hôtel des Neuchâtelois" lived on turtle soup, turtle steak, turtle pie, and turtle roast.

It was really beautiful to see Agassiz struggle to provide for all the expenses of his household. In the three months from September to December, 1848, he had spent three thousand dollars, while his salary at the Lawrence Scientific School was only sixteen hundred dollars a year. John A. Lowell came forward at once, paying him twelve hundred dollars in advance for another course of lectures. But even this was not enough, and Agassiz had to accept every offer made to him for lectures in the towns and villages around Boston. Besides his two regular lectures every week

at Harvard University, and his two Lowell lectures, Agassiz went every afternoon, when not engaged to the Lowell Institute, to some suburban town, like Salem, Framingham, Worcester, etc., and delivered an evening lecture, accepting any offer, however small, which was offered to him. Only his strong constitution enabled him to stand such fatigue; for, as too often happened with him, he was burning the candle at both ends. However, he was happy, for his success as a lecturer was beyond his most sanguine expectation; his audiences being so large that he was obliged to repeat next day each of his lectures at the Lowell Institute. "The Evening Traveller," a Boston newspaper, similar to "The Tribune" of New York, had each lecture stenographically reported, and published it with woodcuts the day after its delivery, and the sale was so great that the newspaper was obliged to reprint each number containing these lectures, and finally to issue them in the form of a pamphlet, under the title, "Twelve Lectures on Comparative Embryology, delivered before the Lowell Institute, December and January, 1848-49," Boston, 8vo. The newsboys in the streets of Boston and Cambridge used to cry Professor Agassiz's lectures at the same time that they announced a revolution in Europe, or a shipwreck of a great transatlantic steamer, or the election of General Taylor as President of the Republic. No one was more popular in New England than Agassiz; he even rivalled the great statesman, Daniel Webster.

During 1848 Agassiz's prominent part on two public scientific occasions showed what a high place he

already held in America as a scientific leader. On May 17 the Boston Society of Natural History dedicated a new building in Phillips Place, at which time the Annual Address was delivered by Dr. D. H. Storer. The new building was very well suited in every respect to the wants of the society, and was filled to its utmost capacity, in expectation of hearing a speech by Professor Agassiz. At the conclusion of the vice-president's address, Agassiz made remarks on the future progress of the natural sciences in America, insisting on the excellent opportunity offered by the political disturbances in Europe, where progress was forcibly suspended for some time to come. If strenuous and sacrificing efforts are made now, he said, they will soon bring results which will place America in the position hitherto occupied by Europe. Tremendous applause from the great audience proved that the American scientific public highly appreciated Agassiz's endeavours to promote the cause of American science.

The second occasion was the ninth annual session of the Association of American Geologists, held the 20th of September at Philadelphia. An organic change in the name and purpose of the society had been proposed at its last meeting at Boston, the year previous, and an enlarged constitution embracing all sciences, somewhat on the same plan as that of the British Scientific Association for the Advancement of Sciences, had been framed by a committee of three, Agassiz being one, and we may say the leading member; for he had assisted at several meetings of the great British association in England, and had even presided over the Société Helvétique des

Sciences Naturelles, a precursor, and the first great European association to promote progress in natural and physical sciences, outside of scientific organizations existing permanently in large cities. Full advantage was taken of his experience in the new organization, and the Association of American Geologists and Naturalists became the American Association for the Advancement of Sciences.

CHAPTER XIV.

1849 (*continued*)–1852.

PHILADELPHIA — LABORATORY WORK AT CAMBRIDGE — ARRIVAL OF HIS SON ALEXANDER — HIS ENGAGEMENT AND SECOND MARRIAGE — ARRIVAL OF HIS DAUGHTERS IDA AND PAULINE — EXPLORATION IN FLORIDA — AMPÈRE'S VISIT — APPOINTMENT AS PROFESSOR OF COMPARATIVE ANATOMY AT CHARLESTON, SOUTH CAROLINA — PUBLICATION OF THREE ARTICLES IN THE "CHRISTIAN EXAMINER," AND HIS OPINION ON A "CHART OF GEOLOGICAL FORMATIONS."

AT the beginning of February, 1849, Agassiz left Cambridge for a prolonged visit to Philadelphia, and having agreed to deliver a course of lectures, he remained there until the middle of April. His success was so great that Philadelphia savants and society leaders approached him with a view to an appointment at the Pennsylvania University, but, as he said, it was too late; his decision was made to remain in Cambridge. During the intervals of his lectures Agassiz was very busy at the Academy of Natural Sciences. The Academy was then the best equipped institution in America. Its museum contained a large number of typical specimens, fossil and living, described by Morton, Conrad, Say, Nuttall, Audubon, Lucien Charles Bonaparte, Harlan, Rafinesque, and others, besides a great quantity of inedited species, and its library was very rich and kept constantly *au courant*

through the liberality of one of the members of the Academy, Dr. Thomas B. Wilson. Agassiz had brought with him his artist Burkhardt and his librarian Hüber, and both had their hands more than full during their stay, for Agassiz's activity knew no bounds. There were at that time in Philadelphia a number of naturalists, the most prominent being Morton, Conrad, Lea, and young Leidy.

Dr. Samuel George Morton was the most remarkable American naturalist then living; unhappily, he was an invalid, suffering from a very serious affection of the heart from which he died two years later. Morton was the real founder of invertebrate palæontology in America. His volume entitled "Synopsis of the Organic Remains of the Cretaceous Group of the United States," 1834, is the starting-point of all palæontological and systematic work on American fossils. His "Crania Americana," 1839, and "Crania Ægyptiaca," 1844, placed him at the head of ethnologists in the Old and New Worlds. It was natural that a friendly understanding should promptly arise between Agassiz and himself, notwithstanding the sad condition of Morton's health. Agassiz became a strong advocate of the doctrine of different species of man; the word "race" being reserved, and applied only to varieties in each species; and, as a contribution to the ethnological researches of Morton, Agassiz wrote, after Morton's death, his celebrated "Sketch of the Natural Provinces of the Animal World and their Relation to the Different Types of Man," which began the first volume of "Types of Mankind" (1854) dedicated "to the memory of Morton."

Agassiz saw a great deal of Morton during his two months' stay at Philadelphia, frequently visiting him, for Morton was already confined almost constantly to his library. I may say that after George Cuvier, Morton was the only zoölogist who had any influence on Agassiz's mind and scientific opinions. Of course, I do not refer to the glacial question, which belongs to another order of studies entirely outside of pure zoölogy. I several times enjoyed the privilege of accompanying Agassiz on these visits, and was much impressed by his enthusiasm. He had, at last, found a naturalist to his liking, without any reserve.

Timothy A. Conrad, then curator of the museum of the Academy of Natural Sciences, was a palæontologist of the first order; but ill-health prevented him all his life from doing himself justice. Although his studies were limited to other departments of palæontology, Conrad was much attracted by the varied and profound knowledge of Agassiz. He delighted in showing him all the rare specimens contained in the museum, and finally he succeeded in organizing an excursion into New Jersey to Timber Creek and vicinity, in order to show the typical upper cretaceous of the Atlantic States. Agassiz was suffering at that time from overwork and anxieties of all kinds, and it was with difficulty that he was persuaded to be one of the party. On a beautiful early spring day in March, after awaiting at Camden the arrival of Agassiz, who was never an early riser, the party, composed of Conrad, Agassiz, Leidy, Dr. Hallowell, myself, and two of Agassiz's Cambridge students, started for Timber Creek, under the guidance of Dr. Harris, a

resident of that part of the country. We saw the celebrated New Jersey greensand, and collected in it a quantity of sauroid teeth, fragments of vertebræ of a crocodilian, *Ostrea vesicularis*, *Terebratula Sayii*, *Pecten*, *Arca*, *Mya*, etc. Above the greensand and green marls there are yellow sands and yellow calcareous sandstone containing many echinoderms, such as *Holaster*, *Nucleolites*, *Diadema*, *Hemiaster*, *Ceratomus;* and many *Teredo*, *Scalaria*, and corals; the whole formation belonging to the lower chalk and upper greensand of England. The excursion was very successful, and Agassiz returned to Philadelphia in better health and spirits.

Dr. Joseph Leidy, so justly celebrated since for his great works on the comparative anatomy of American fossil vertebrates, was then a young student just returned from Paris, where he had followed the lectures and also the private instructions of de Blainville, the successor of Cuvier in the chair of comparative anatomy. Leidy was the naturalist who followed, with the greatest attention and best results, the lectures of Professor Agassiz, and received the most benefit from his presence in Philadelphia. Agassiz was much impressed by his modest manner, and predicted a great future for him if he would devote his life to comparative anatomy. Many fêtes were given by Philadelphia society in honour of Agassiz, and it was not without regret that on April 11 he left the city of Penn, returning directly to Cambridge.

Resuming his duties at Harvard University, he devoted himself, during the year, to microscopical studies, more especially of the *Acalephæ* or *Medusæ* of the shores of Massachusetts, which resulted in the publication of

a monograph in two parts, in the "Memoirs of the American Academy of Sciences," of which the sixteen quarto plates, drawn on stone from nature by Sonrel, are simply superb. This first contribution of Agassiz to the natural history of the United States marks a new departure in America, in that it shows the structure, the generic peculiarities, and all the characters of the muscular system in very low animals.

Agassiz gave a great part of his time also to directing the publication of his volume on Lake Superior. Curiously enough, he wholly abandoned his "Principles of Zoölogy." His collaborator, Dr. A. A. Gould, wrote, during 1849 and 1850, the second part, as he had already written with success the first part; but from year to year Agassiz delayed reading and correcting the manuscript, until it was too late to publish it. It was one of the foibles of the great naturalist not to finish promptly the work already begun, but to let it drop in order to undertake other work. However, the success of the first part on "Comparative Physiology," which was issued in 1848, was great, and several editions were printed. The work was quickly pirated in England by unscrupulous editors. A German translation by Professor Bronn, the celebrated palæontologist of the University of Heidelberg, was published at Stuttgart in 1851; and a French translation, by the great geographer Élisée Réclus, was printed in Paris, in the "Magasin d'Éducation et de Récréation," as late as 1891, under the title "Principes de Zoologie." The work had great influence in America, the three editions of 1848, 1851, and 1861 being extensively used by professors and

students, and it is to be regretted that it was never completed.

A great pleasure was in reserve for Agassiz; namely, the arrival of his son Alexander in the middle of June, 1849, brought from Neuchâtel by a cousin, Dr. Mayor, and the evangelist, Marc Fivaz, of Newark Valley, in the state of New York, the first naturalist companion of Louis Agassiz at Orbe. Born at Neuchâtel the 1st of December, 1835, Alexander, as he was christened, in honour of his uncle, Alexander Braun, was a lad of thirteen years, well developed and fine looking, but more serious and inclined to solitude than boys of his age generally are. Agassiz was delighted and grateful for all the marks of interest and kindness shown his son by every one in Cambridge and Boston. In a letter to me, dated Cambridge, June 20, 1849, Agassiz says: "Je reviens de New York avec mon fils, c'est vous dire que je suis bien heureux maintenant. C'est dans toute la vérité de l'expression et à part de la partialité paternelle un charmant garçon."

From the first day of his settlement at Cambridge, Agassiz was befriended by both Professors C. C. Felton and Benjamin Pierce. Every day they called at his house, and generally more than once, helping and cheering him by true friendship. Professor Felton, whose second wife was the granddaughter of Colonel Perkins,—a merchant-prince of Boston of the beginning of this century,—had a very attractive home, in which Agassiz was always welcome, and even indulged to his heart's content. Felton was an extremely amiable man, and a scholar of repute; and mutual attraction soon brought

him and Agassiz together in an intimacy which lasted until the death of Felton in 1862.

Mrs. Felton saw quickly the influence she exercised over Agassiz, and used it for his advantage. Agassiz was always in need of good advice; for in almost all the walks of life outside of science he was like a child, completely lacking in knowledge of men and good judgment in matters of domestic life. He formed the habit of asking the advice of Professor and Mrs. Felton, and what is better, he followed it as far as it was possible with his enthusiastic nature.

When a youth in Germany, Switzerland, and Paris, Agassiz wore a heavy moustache, which he was obliged to cut rather reluctantly when appointed professor at Neuchâtel, where the society was then formal and conventional. During his exploration on Lake Superior he had let his moustaches grow, and came back to Cambridge with a formidable pair. Then moustaches were absolutely abhorred in America, so much so that I was insulted repeatedly in the streets of Buffalo, Cleveland, and Detroit, because I wore a light moustache and a light beard. As soon as Mrs. Felton saw Agassiz on his return, she had no difficulty in persuading him that a moustache was not becoming to him, which was true enough; and the next day Agassiz appeared completely shaved, with the exception of slight whiskers, which he wore until the end of his life.[1]

[1] It may seem too unimportant and even trivial to refer to such a small matter, but it shows the strong prejudice then existing in America against moustaches, a prejudice which was soon to disappear with the great Civil War.

Mrs. Felton's second sister, Miss Elizabeth C. Cary, had always felt a great admiration for the rare gifts of Agassiz as a public lecturer since his first course of lectures at the Lowell Institute, and as she was a constant visitor at her sister's house, a friendship soon sprang up between Agassiz and her which in due time on his part changed into courtship.

After the return of Agassiz from Philadelphia, the engagement was announced, the marriage taking place at King's Chapel early in the spring of 1850.

It was certainly the best thing Agassiz ever did in the course of his whole life.

However, at first the news of the engagement did not please Agassiz's old friend, M. Christinat, and his Swiss family. With Agassiz's habit of spending money lavishly in every direction, Christinat and Mrs. Agassiz, the mother, thought that if he married again he ought to marry a very rich wife, able to support a great establishment, as his salary would never be sufficient to carry out one-tenth part of the schemes of which his head was always full. Miss Cary had no fortune of her own, and Christinat, although very favourably impressed by the young lady, opposed the marriage, because he thought that instead of helping Agassiz, it would add a new burden and be the occasion of additional expense. As soon as he saw that the engagement was concluded, Christinat resolved to leave Cambridge, being unwilling to witness the marriage; and, therefore, in November, 1849, secretly, without a word to Agassiz, who was absent on a lecturing tour in Massachusetts, he left

Cambridge, embarking for New Orleans. He kept his own secret, and Agassiz did not know of his whereabouts until more than a year later, when he learned that he had passed the year at New Orleans, as pastor of a Swiss church there. Agassiz, who knew the difficulty of his family's position, urged him to finish his life with his "viel ami," and when his fiancée was made acquainted with the arrangement, she cordially acquiesced; but it was all in vain. Christinat, to my great surprise, recognized me one day in a church in Paris early in January, 1851; he was returning to Switzerland, after a rather trying experience in Louisiana, where there had been a severe epidemic of yellow fever, from which he escaped almost miraculously. He was reinstalled as pastor over his old parish at Montpreveyres, Canton de Vaud, in April, 1852, and died there the 20th of February, 1855.

Instead of being a burden in her new home, Mrs. Agassiz was an invaluable addition, and a comfort to all. An excellent manager of her household, she at the same time undertook to act as secretary to her husband, always ready for any new task. It was, indeed, remarkable to see a young lady, brought up in great comfort and leisure, enter a life full of responsibilities of all kinds, even becoming an authoress in order to help and please her husband. She was and is still the guardian angel of Louis Agassiz and his whole family of children and grandchildren; and blessed was the day for Agassiz when she stepped into his house in Oxford Street.

Christinat was not the only inmate of the second "Hôtel des Neuchâtelois" who left it during 1849 and 1850. First, Pourtalès received an appointment in the United States Coast Survey, and became a resident of Washington. Guyot brought over his rather large family, and settled for a time in Cambridge. Lesquereux went West, and made his home at Columbus, Ohio. Charles Girard went to Washington, as an assistant of Professor Spencer Baird, at the Smithsonian Institution; and, finally, the librarian, Hüber, returned to Switzerland, at the end of 1849. To him is due, in a great measure, the executive part of the "Bibliographia Zoologiæ et Geologiæ," and to him and Girard together, the rather difficult work of the "Nomenclator"; and because of his scholarship and linguistic ability, he was sent by Agassiz to Soleure, in 1846, to arrange for the printing of the "Nomenclator."

At the end of August, 1850, Agassiz's two daughters arrived, in the care of the good cousin, M. Auguste Mayor, who was always ready to help his friends and relatives, and all Louis Agassiz's family was at last gathered under his roof. It was a great achievement, and an immense relief to his mind, after many years of anxiety and suffering, and a new life was now in store for him.

Once surrounded by his children, Agassiz recollected all his younger days and life in Switzerland; and Mrs. Agassiz had the happy thought of putting on paper all she heard, in the form of a journal, which she has since used to much advantage in the first half of the first vol-

ume of Agassiz's Life. Agassiz corrected the manuscript; and it was occasionally read aloud to his children, as an exercise in their English studies.

It was no small task for Mrs. Agassiz to manage a family which, until then, had never used the English language, and whose manners and thoughts were those of the French Swiss, with many German elements. She applied herself with rare perseverance, much gentleness, constant watching, to Americanize the whole family. As a rule, she never spoke French, although understanding it perfectly. Her uniformly calm manner and temperament helped her immensely; she took everything quietly, never losing her temper, always serene, and determined to attach Agassiz and his children to America, at whatever cost.[1] She was admirably seconded by her sister, Mrs. Felton; and it is not too much to say that to these two ladies is due Agassiz's remaining in the New World and the Americanization of his children and grandchildren. At first Agassiz was easily won; he even affected, during the first twelve years of his union with his second wife, to see and hear nothing but what was American, severing almost every tie with Europe. If it had not been for the prolonged life of his mother, who died only seven years before him, he might have been considered a devoted naturalized American citizen. But a gradual change came

[1] There is a sentence taken from a French author, very applicable to the second marriage of Agassiz: "Il n'y a d'amitié durable et féconde qu'entre gens qui ne se ressemblent pas." How true of Agassiz and his second wife. They differed in every way: education, character, disposition, and ideas.

over him after his journey to Brazil; more and more frequently he remembered his Swiss origin, and became more and more attached to the French civilization.

Early in January, 1851, Agassiz started for an exploration of the Florida coral reef. His friend, Professor Bache, the Superintendent of the Coast Survey, secured his valuable services and put at his disposal and under his orders the schooner *W. A. Graham*, of the Coast Survey. During his ten weeks' survey he studied the growth of coral reefs, their mode of living, the different forms and associations of animals in the reef and around it; and the recent and present formation of shell limestone and oölitic limestone; but he found no traces of upheaval or subsidence, even at the Tortugas.

In August, 1851, Agassiz addressed his report to Professor Bache, who published extracts from it in his Annual Report, Washington, 1852, on pp. 145–160. Bache was so impressed by the Report, that he asked Congress for an appropriation to give the entire results in detail, with drawings of all the species of corals; and the specimens were put directly into Sonrel's hands, to be drawn on stone from nature. The plates were all struck in beautiful style and are works of art by themselves; they were even paid for by the United States government; but this was all, for it was impossible to get the text describing the species. I saw Agassiz, just after his return from Florida, full of his subject, enthusiastic, as he always was, urging M. Sonrel to finish the plates as quickly as possible, and I certainly thought that his full observations would be before the

scientific world in a year or two at most, and would give new views on coral reefs, barrier reefs, and atolls, entirely different from those presented by Darwin, Couthouy, and Dana in describing those of the Pacific Ocean.

Agassiz always had more irons in the fire than he could manage, and instead of diminishing their number, he was constantly increasing them. Happily, his son, long after his death, took hold of the plates, reprinted the whole of the Report sent to Professor Bache in 1851, and with the help of Pourtalès, who named all the figures, issued in 1882, in Vol. VII. of the "Memoirs of the Museum of Comparative Zoölogy," the final "Report on the Florida Reefs," by Louis Agassiz, 4to, Cambridge. The editor has added at the end of the paper a chapter "entitled, Sketch of the Florida Reefs and Keys," extracted from a small volume of Louis Agassiz, entitled "Methods of Study in Natural History," Boston, 1863, 12mo.

The great number of specimens collected in Florida, added to the already important collections gathered at his house and at the old bath-house by the Charles River, made it an absolute necessity to build a sort of laboratory with a lecture-room, and a quantity of drawers for the display of the specimens. A wooden structure, for the storage of the specimens preserved in alcohol, was therefore erected on the college grounds, to the left of the chemical laboratory and engineer's room of the Lawrence Scientific School, close by the present Hemenway Gymnasium, and was ready for occupancy in

the spring of 1852. It was only a temporary museum — a rather dangerous wooden structure for the storage of specimens kept in alcohol. The University voted a sum of four hundred dollars annually for the preservation of the collections; and some friends started a subscription of twelve thousand dollars to purchase them for the Lawrence Scientific School, as the expense incurred by Agassiz was too great to be borne by a man without a private fortune.

On a beautiful September afternoon of 1851, when crossing that college yard now occupied by Memorial Hall, I was stopped by a gentleman in full dress, — frock coat and black pantaloons of an old pattern, and too short by six inches, showing the upper part of his boots, — who asked me, in broken English, to direct him to M. Agassiz's house. "I am going there myself," I answered in French. "Oh! vous êtes français; je l'ai pensé en voyant votre barbiche et moustache, car depuis mon arrivée à Boston, je n'ai vu personne que vous et moi avec des moustaches." We walked along leisurely, and I thought from his conversation that he was a countryman from the Canton de Vaud — perhaps a rich Swiss farmer. Agassiz was at home, and, on seeing my companion, exclaimed: "Oh! M. Ampère!" In fact, it was no less a person than the son of the great electrician and physicist, André M. Ampère, himself a very remarkable scholar and savant in his way, and distinguished in literature, and the last admirer and lover of the beautiful Madame Recamier. His visit pleased Agassiz much, showing as it did that he was not for-

gotten by his numerous Paris friends. Both were great and most agreeable talkers; and reminiscences of all kinds so rapidly succeeded each other, and time passed so quickly, that M. Ampère was persuaded to pass the night at Agassiz's house.

It may be said that Ampère[1] was engaged, when a young man, to marry the daughter and only child of George Cuvier, an engagement which was broken by the early death of the young lady. The acquaintance of Agassiz with Ampère dated from their constant meeting at the house of Cuvier. Next day, late in the morning — for both Ampère and Agassiz were confirmed *noctambules*, and they had not retired until nearly two o'clock in the morning, — their conversation was resumed; and the whole day passed rapidly, the only interruption to their reminiscences being a visit to Mount Auburn Cemetery, where Ampère was much interested not only in the beauty of the place, but also in finding the tomb of Spurzheim, an old acquaintance made in Paris in the twenties; and he lingered also a long time before the tomb and statue of the mathematician, Nathaniel Bowditch, an old correspondent of his father.

Postponing his departure from day to day, Ampère, who came only to pay a visit of a few hours, remained a week. Agassiz gave a great dinner party, to which all the Cambridge professors were invited to meet Ampère, who thus had an opportunity to see Longfellow, Sparks,

[1] Jean Jacques Antoine Ampère, born at Lyon, August 12, 1800, died at Pau, March 27, 1864.

Felton, Pierce, etc. Longfellow especially pleased him much, and both became absorbed in reciting old French verses, for Ampère was somewhat of a poet himself, and was also professor of old French literature at the Collége de France, at Paris.

Ampère-like, — for his father and he were celebrated for their absent-mindedness, — he stayed eight days, saying every morning that he was going back to Boston; and not only remaining, but, as each day passed, forgetting even to bring a change of linen from his Boston hotel. How he managed to keep up appearances with the same shirt was a problem which furnished great fun to Agassiz's children, who were disposed to see the comical side of their father's extraordinary guest. Every morning Ampère's shirt collar was lowered, in order to conceal the mark of the preceding day, until the collar wholly disappeared on the last day. Then he found his way back to the Tremont House. Good Ampère! He was a well of knowledge, ready to talk for hours on zoölogy, botany, geology, palæontology, old French, history, political economy, philology, travels, physics, chemistry, poetry, glaciers, fine arts, romance languages (such as Provençal, Italian, Spanish), German literature; in fact, on any subject, like a veritable encyclopædist.

Appointed professor of comparative anatomy at the Medical College of Charleston, South Carolina, Agassiz assumed his new duties in December, 1851, his lectures being delivered every winter, between his autumn and spring courses at Cambridge. He took with him all his family, besides two assistants, Clark and Stimpson, and

the artist Burkhardt, — a rather cumbrous establishment so far from Cambridge. Always most hospitably received by the Charleston savants and the "élite" of Charleston society, he found opportunity to deliver not only his courses before the Medical College, three times a week, but also an evening course of lectures to the public in general. But the strain was too great, and his health began to break down. Sullivan's Island, a few miles south of Charleston harbour, where he established his laboratory, did not agree with him. He was constantly feverish, and the South Carolina climate was decidedly unfavourable for him.

Before leaving Charleston he learned with joy that the French Academy of Science of the Institute of France had bestowed on him its first award of the "Prix Cuvier," in consideration of his splendid and difficult work, the "Poissons fossiles." This prize was founded with the money remaining from a public subscription to raise a marble statue of Cuvier in the geological gallery of the Jardin des Plantes, and a monumental fountain at the corner of Cuvier and St. Victor streets, close by the gate of the Jardin des Plantes, in the Pitié Square. It was a reward well bestowed, honouring both the Academy and the recipient.

Agassiz, about this time, had two curious experiences, for which his previous European training had not prepared him. To his great and disagreeable surprise, he found himself entangled in two somewhat serious difficulties almost before he was aware of it. The religious world, always so powerful in America, and more espe-

cially in New England, closely followed Agassiz's teachings. In one of his letters, lately published, Asa Gray expressed himself as well satisfied with the ground taken by Agassiz on all spiritual matters; and, thus encouraged by one of his colleagues of Harvard College, who called himself an "orthodox Presbyterian" of the old Puritan school, he made no objection to the request of some of the leaders and editors of the "Christian Examiner" of Boston, to write a few articles for that periodical; and during 1850 and 1851 he published three articles on questions of natural history. The first paper, on "Geographical Distribution of Animals," March, 1850, was well received by every one; but this was not the case with the next article, "The Diversity of the Origin of the Human Races." Although he took the scientific ground, and insisted most strongly that there are two distinct questions involved, — the Unity of Mankind, and the Diversity of Origin of the Human Races, — it was taken by some as a sort of support of slavery, and the abolition party became angry and excited. Finally his third paper, published in January, 1851, "Contemplations of God in the Kosmos," seemed to many religious men to make too light of Genesis, and to pass over Adam as if he had never existed. Newspapers reviewed the three articles, and some sharp criticisms were made against Agassiz, not only in America, but also in Europe. As is often the case, some, without even reading the articles, took it for granted that Agassiz wrote them in order to please the Methodists and the slave-holders; while others, hardly

better informed, accused him of agnosticism, because he mentions "those whose religion consists in a blind adoration of their own construction of the Bible." Having displeased abolitionists, atheists, and pietists, he declined to furnish any more articles to religious periodicals.

His second disagreeable experience at about this same period had to do with savants. The palæontologist of the state of New York came to Cambridge one day in November, 1849, with a large manuscript "Chart of the Geological Formations," intended for the use of the common schools of the whole state of New York. Agassiz indicated some improvements and additions, and gave a written testimonial. Some time after, he received a copy of another chart of the geological formations made by another person, with a request for his opinion. The sending and request came not directly from the author, but through the palæontologist of New York. Agassiz, accustomed in Europe to give freely his opinions on scientific matters, did not pause an instant to reflect, but wrote a letter disapproving this second chart. Armed with this letter and Agassiz's previous approval of his own chart, the palæontologist of New York succeeded in obtaining from those in authority at Albany the acceptance of his chart[1] and the refusal of the other. The author of the second chart, having learned that the rejection of his chart was due mainly to the opinion expressed by Agassiz

[1] "Key to a Chart of the Successive Geological Formations, with an Actual Section from the Atlantic to the Pacific Ocean. Illustrated by the Characteristic Fossils of Each Formation." By James Hall, Boston, 1852.

in a private letter, sued Agassiz for damages before the court of justice at Albany. A rather long and expensive trial followed; and although Agassiz won his case, and showed that a savant had a right to give his opinion upon any published scientific subject, he was considerably annoyed by the proceedings, and never afterward recommended anything for publication. The truth is, that both charts were poor, and the choice between the two was rather embarrassing on that account. Agassiz's good faith, reputation, and friendship have been too often used for money-making without scruple, and not always for the good of science.

CHAPTER XV.

1852 (*continued*)–1855.

Lectures before the Smithsonian Institution at Washington — Agassiz's Intimacy with Professor Henry and Professor Bache — Life in Cambridge — His First American Pupils and Assistants — Serious Illness at Charleston — Last Days at the Oxford Street House — Removal of his Household from Oxford to Quincy Street — Agassiz's School for Girls.

After leaving Charleston, Agassiz stopped at Washington, to deliver a course of lectures at the Smithsonian Institution, on the "Foundation of Symmetry in the Animal Kingdom." He had already lectured once before, at the Smithsonian, in 1850, on the "Unity of the Plan of the Animal Kingdom." The great Institution, which has since done so much for American science, and indeed for the whole world, was then in its infancy, for it had begun its operations soon after Agassiz's arrival in America, the "First Report" of the secretary, Joseph Henry, being dated Dec. 8, 1847. Professor Henry was much attracted by Agassiz's immense store of scientific knowledge and his great experience of European academies, scientific societies, scientific journals, and personal acquaintance with all the leaders, — from George Cuvier, to Humboldt, Arago, and Leverrier, — and quickly took advantage of his

presence in America to become intimate with him, after a few years of acquaintance. The apartment he occupied in the Smithsonian Building was thrown open to Agassiz, as often as he visited or passed through Washington. Agassiz enjoyed in Henry not only his great capacity as an original observer in experimental physics and meteorology, but also his capability as a scientific administrator. Everything was to be done at once; and Henry was very glad to be able to consult Agassiz on everything connected with natural history, great collections, scientific libraries, and relations with foreign societies, institutions, and scientific bodies. The first list of foreign academies and scientific societies was suggested in a great measure by Agassiz, who asked me to help him. The instructions for collecting natural history subjects were partly translated from the "Instructions pour les voyageurs," par l'administration du Muséum royal d'Histoire naturelle (4ième édition, Paris, 1845), of which I gladly offered copies to Agassiz and Henry. Of course, Agassiz, Baird, and Girard added a great deal to those instructions, which have contributed so much toward making the United States National Museum the greatest depository of American natural history specimens.

Although constantly in relation with Henry and his assistant, Baird, Agassiz was not appointed one of the regents of the Smithsonian Institution until Feb. 6, 1863, in place of Mr. Badger, removed, as a "traitor," during the Civil War. In the Annual Report of 1862, printed in 1863, Agassiz is for the first time on the

list of regents, being the last of the list; and from that time until his death he was a constant attendant at the meetings, taking great interest in all that related to the Institution.

Professor Alexander Dallas Bache, the justly celebrated director of the United States Coast Survey, was the first American savant to appreciate what a valuable addition Agassiz was to American science; and he at once put at his disposal all the vessels and steamers employed in surveying the Atlantic coast. A very strong friendship rapidly sprang up between them, and though the two men were entirely different, they admirably supplemented one another. Bache was a good and accurate mathematician, and inherited from his grandfather, Benjamin Franklin, great administrative power, — two things entirely wanting in Agassiz, who knew absolutely nothing of mathematics, or even of arithmetic, and was a rather poor administrator, as we have seen.

Bache preceded Henry at Washington by three years, having been appointed Professor Hassler's successor as superintendent of the United States Coast Survey, in December, 1843. Under his direction, the bureau became very important; and he had the good judgment to choose for his principal assistants the most able young officers of the army, such as Major Isaac I. Stevens, afterwards governor of Washington Territory, and major-general, United States Volunteers; Lieutenant A. A. Humphrey, afterward chief of the staff of Meade during the last Virginia campaign, and brigadier-general and chief of engineers,

United States army; and many others. The publications of the Coast Survey, which, until then, were limited to marine charts, were largely extended to geographical subjects, astronomical expeditions, and studies of the coal reefs, and tidal researches.

For many years, we may say that the triumvirate of Bache, Henry, and Agassiz led American science, and, on the whole, they gave the strongest impulse science has received on this side of the Atlantic.

Life in Cambridge was resumed with great relish by Agassiz. He was full of schemes for new researches and publications, and his activity was as great as it had ever been before. Society claimed his presence in Cambridge and in Boston, and, as he was very fond of social occasions, he accepted all invitations. He became very popular with the members of the various clubs which he joined, and his presence enlivened the tables of all the "élite." Felton and he were inseparable, and it was a pleasure to hear them in after-dinner talk. Agassiz was very genial and would talk for hours; Felton was also full of anecdote; and both were charming companions. They had royal times together, rarely returning home until one or two o'clock in the morning. Such late hours made early rising out of the question, and Agassiz was seldom at his breakfast table before eleven o'clock, often not before twelve o'clock. Then, after lighting a cigar, he would start for his laboratory, where he would examine some wonderful organisms with the microscope, directing the attention of his pupils to some special point, correct their drawings, and encourage them in every way; for he had no equal

in the art of instigating researches, and inspiring his hearers with desires to accomplish something grand and new to science.

The pupils of Agassiz in America may be divided into two series: the first dates from his arrival until the opening of his Museum of Comparative Zoölogy in 1860, and the second, from the opening of the Museum until his death. I shall only notice those who have gained celebrity in the scientific world.

His first pupil was his son Alexander, upon whom Agassiz bestowed much of his time. Of course, in this case, paternal love was interested, and some anxiety was caused, when, after graduation from college, and lecturing for two years at his school, Alexander entered the United States Coast Survey as an assistant, and departed for a survey of the mouth of the Columbia River (Oregon). However, he returned in July, 1860, a few months before the opening of the Zoölogical Museum, and devoted himself to the work of arranging the collections of animals preserved in alcohol, — by no means an easy task. His success in studying marine animals, and more especially echinoderms, was a great pleasure to his father, who was justly proud of his beautiful and excellent monograph, "Revision of the Echinoderms," Cambridge, 1872. Since this time Mr. Alexander Agassiz has become an expert and an authority on animals obtained from deep-sea soundings, not only in the Gulf of Mexico and along the Atlantic coast, but also in the Pacific Ocean; and he is considered the best specialist on living echinoderms.

The second pupil of this first set was William Stimp-

son, an extremely bright young Cambridge student, with no small amount of originality. Stimpson took at once to dredging along the sea-bottom, in order to investigate and determine provinces of marine life, more especially of the Mollusca. He was strongly impressed by Edward Forbes's researches in that line, and followed in his steps, not only on the shores of the British Isles, but on the coasts of Maine, Massachusetts, Maryland, Virginia, the Carolinas, and Florida, adding greatly to that branch of natural history. After leaving Professor Agassiz's laboratory in 1855, Stimpson was attached to the Smithsonian Institution at Washington, and did much, in collaboration with Dr. Charles Girard, to create the collection of living marine invertebrates of the United States National Museum. Having agreed to found and direct a museum of natural history at Chicago, he had the misfortune to see all his manuscripts and collections destroyed by the great Chicago fire of October, 1871. Although Stimpson died young, he left an imperishable name in conchology.

H. James Clark, also a graduate like Stimpson of the Lawrence Scientific School of Harvard University, was the favourite pupil of Agassiz; his investigation of the embryology of turtles, and his microscopic illustrations of all the researches of Agassiz, contained in his "Contributions to the Natural History of the United States of America," show a rare amount of patience, and great accuracy as an original observer. Clark possessed a quality which was much admired by Agassiz; namely, steadiness in work. He was indefatigable at the microscope, day after day, month after month, year after

year. In the eyes of Agassiz, everything and every one in his laboratory was second to Mr. Clark. In the construction of his house on Quincy Street, in 1855, he took special care to have a stone pillar placed where it would receive the best northern light for Clark's microscope. He did the same when, in 1860, he built his great museum. In fact, Clark was his right hand during almost twelve years. I quote a letter from Agassiz which will show the great place Clark occupied in the scientific organization of Agassiz's establishment: —

CAMBRIDGE, 24 juillet, 1860.

MON CHER PICTET (Jules Pictet de la Rive, à Genève).

C'est un vrai plaisir pour moi de vous présenter mon collègue, Mr. H. J. Clark, celui de tous mes élèves dont j'attends le plus. Vous verrez bien qu'il a embrassé l'histoire naturelle dans son ensemble, et je ne crois pas qu'il existe un naturaliste, plus habile que lui dans l'emploi du microscope.

Tout à vous,

LS. AGASSIZ.

Clark was appointed adjunct professor of zoölogy at Harvard University, on the special recommendation of Agassiz. As had happened before, Agassiz, with his enthusiastic and sanguine temperament, had raised hopes of pecuniary position in Clark's mind, as soon as his great museum should be inaugurated, which it was impossible to gratify, at least immediately. Disappointed in his expectations, and with a large family to provide for, Clark's conduct was such that he was obliged to resign his position at Harvard; the difficulty having become so personal that Agassiz simply said to the Board of Trustees that he or Clark must leave. In such a dilemma, the question was of necessity decided

against Clark. The case was a particularly trying one, and is much to be regretted. Poorly paid, — receiving hardly enough to sustain his family, — Clark thought that the least he could receive from Agassiz was public acknowledgment of collaboration on the title-pages of the second, third, and fourth volumes of the "Contributions to the Natural History of the United States." Instead of this, Agassiz contented himself with saying in the prefaces that he had "received much valuable assistance" from his friend and colleague, "Professor H. J. Clark," who had "assisted him from the beginning of his investigations of the embryology of these animals with untiring patience and unsurpassed accuracy." On the point of authorship, Agassiz was very sensitive and easily offended, and would not allow any one to interfere. Clark asked him in vain to refer his claim to "an arbitration by competent umpires." Agassiz declined to consent to such a demand, which he considered as rather preposterous from an old pupil.

Then Clark published in July, 1863, a small pamphlet of three pages only: "A Claim for Scientific Property," over his signature and title of adjunct professor of Harvard University, which brought the affair to a crisis and caused his dismissal. Clark never rallied from the shock, and died at Amherst the 1st of July, 1873, a few months before Agassiz's death. I do not hesitate to say that this was the most unfortunate scientific difficulty with which Agassiz was connected. Although he was right in the main, he might have shown more len-

iency to a favourite pupil, and have given him full satisfaction, by inscribing his name as collaborator on the title-page of the three volumes, without diminishing in any way his own share in the work. Cuvier did so with Valenciennes, in his "Histoire naturelle des Poissons"; and with that precedent Agassiz might have granted Clark's claim.

The case of Karl Vogt's claim in regard to the "Anatomie des Salmones" is different; for Vogt had his name recorded as collaborator on the title of the work. Had Agassiz done the same with Clark, he would have raised himself above the petty question of scientific ownership of a few observations or thoughts, which it is always very difficult to decide in the case of two observers engaged together on the same work and daily exchanging their views.

Mr. James E. Mills, who worked out for Agassiz the special characters of the families of turtles, removed to California in 1858, where he has since lived, engaged in gold mining and practical geological work in the Sierra Nevada and other parts of Central California, as well as in Brazil.

Dr. David F. Weinland, a German from Frankfort-on-the-Main, helped Agassiz in his work on the "Anatomy of the Turtles," between 1856–58, and is referred to in the Preface, p. xv, of "Contributions to the Natural History of the United States," Vol. I.

Theodore Lyman, who was graduated in the same year as Alexander Agassiz, 1856, was another favourite pupil of Agassiz. In 1857, he made an exploration of

Florida, returning with a rich collection of echinoderms, corals, etc., which he presented to the Museum. He has devoted most of his zoölogical researches to the interesting and beautiful families of the Asteroides and the Crinoides of the present fauna, though during the last twenty-five years the number of Crinoides has increased to such an extent that he has been hardly able to describe the new species brought up from the deep seas by the different expeditions. Lyman is the authority for everything relating to living Crinoides; but unhappily, on account of his health, he has been obliged to give up all work at an age when it was expected that he would much increase our knowledge as well as assist Congress, of which he was a member for Massachusetts, in the reform, so much needed, of the scientific organizations of the United States government.

The following letter from Agassiz to his friend, Jules Pictet de la Rive, of Geneva, will give an idea of the high esteem and friendship he felt for Theodore Lyman: —

CAMBRIDGE, 11 juin, 1861.

Mon cher ami, — Permettez que je vous présente Mr. Th. Lyman de Boston, un de mes élèves de prédilection, et beau-frère de mon fils, qui se rend en Europe avec sa femme pour voir le monde, et faire la connaissance des savants d'outre-mer. Je vous le recommande tout particulièrement comme mon ami et comme un géologiste plein d'avenir.

Votre tout dévoué,

LS. AGASSIZ.

Fred. W. Putnam, of Salem, joined the laboratory

and class of Agassiz at the beginning of 1856, making a specialty of living fishes, and took charge of that important branch of the collections when the Agassiz Museum was inaugurated in 1860. He has since entirely given up his zoölogical work, and turned to ethnology and prehistoric man, and is now director of the Peabody Museum at Harvard University.

I may add to this first list of Agassiz's pupils in America the entomologist, Dr. John L. Leconte, who often came to Cambridge as a guest of Professor Agassiz, and learned much from the great store of knowledge and methods of studying of the professor; and as an acknowledgment of the benefits received from these visits, he bestowed his large, important, and rich entomological collection upon the Agassiz Museum. Dr. Joseph Leconte, a cousin, was also a pupil at Charleston, South Carolina, and also at Cambridge. He has since published a Manual of geology, based in part on the lectures of Professor Agassiz, which has given him a certain reputation, and he has also become professor of geology at the State University of California.

Agassiz's annual visit to Charleston, South Carolina, was attended by most serious illness, — an attack of that southern fever generally called *malaria*, — which brought him to death's door. His life was at moments despaired of, and he was in great danger for many days. This illness incapacitated him for two months, from Christmas, 1852, until the end of February, 1853, when, with his unconquerable energy, he again began to deliver his lectures before the Medical

School. The Charleston climate had always disagreed with him; and at each of his four visits, from 1847 to 1852, he suffered an attack of sickness, either while there or as soon as he left. His South Carolina friends, Drs. Holbrook and Ravenel, who had taken such good care of him during his last illness, advised him not to return, and he consequently resigned his professorship at the Medical College.

As soon as his lectures were finished, he started for a prolonged tour in the South, delivering lectures at Mobile, New Orleans, and St. Louis. The Mississippi River was a wonder to him, with its muddy waters, and its rich fauna of fishes, turtles, and caimans. He had there, on a smaller scale, the spectacle which so much impressed Spix on the Amazon, and which had haunted him ever since he had described Spix's fishes at Munich in 1829. The journey up the Mississippi increased, if possible, his desire to explore the Amazon; a desire which he finally realized fourteen years later.

By this time his house on Oxford Street was overcrowded by inhabitants, books, and all sorts of *impedimenta*. Agassiz was still so full of future work, and he was so eager to accumulate materials of all sorts for studies, that he brought home everything he could lay his hands upon. As an illustration I may give a personal recollection. During May, 1853, he drove to my house in Dorchester, and packed his two-horse carriage full of my books, such as the publications of the Geological Society of London, a full set of the reports of the British Association for the Advancement of Science,

and a quantity of volumes on the geology and palæontology of France and Italy. As I was on the eve of an exploration from the Mississippi River to the Pacific Ocean for the United States government, and expected to be absent at least a year, Agassiz thought that he might want to consult many of my books during my long absence, and he therefore carried them to his house. This shows also how scarce scientific books were then in America. The few savants scattered over New England were obliged to borrow from one another the memoirs they wished to consult in their work. Now with such rich libraries as we have at our disposal, it seems hardly possible that only forty years separate us from that time of difficulty in consulting all the publications needed for a special study. Agassiz was thinking of those times when, eight years later, after he had gathered a valuable natural history library at his museum, he generously offered to allow American naturalists to borrow all the books they wanted.

A larger house had become an absolute necessity; and accordingly Harvard College built one for him, on a piece of its ground at the corner of Quincy and Harvard streets, just opposite the house of his friends, the Feltons. He left the second Hôtel des Neuchâtelois in Oxford Street during 1854, after a sojourn of seven years; and it may be said that Agassiz passed there the happiest time of his life. For there he was freed from that sort of nightmare which hung over him so long, his abnormal and never well-defined association with his secretary, Desor. There he received and lived

with his children; while living there he was married, and there also he entertained all his American and European friends.

The main difficulty that Mrs. Agassiz had to contend with as soon as she entered the Oxford Street house was to obtain a regular supply of money for daily household expenses. At last she realized that it was almost hopeless to expect a reform of Agassiz in this direction, and she herself took the matter in hand. With the help of the two oldest children, Alexander and Ida, she decided to open a school for young ladies and girls, and to locate it in the upper story of the great house in Quincy Street. Agassiz, whose strongest passion had always been for teaching, was enchanted with the scheme, and entered into it with great enthusiasm.

Mrs. Agassiz had the whole management of the school; everything was referred to her, as director. It is important to remark that she had had absolutely no experience in teaching, either in a public or private school. She had received her education from an English governess in her family, and did not enjoy the advantage of a school education bestowed upon almost all American girls. Nevertheless, she took the directorship of Agassiz's school in a masterly way, and succeeded admirably. She herself did not teach, but everything regarding the teaching came under her supervision. As the fees were high, the school was a very select one; and pupils came from different parts of the United States, even from as far west as St. Louis. It was considered a great privilege to be taught by such a

naturalist as Agassiz, and all the girls whose parents could afford it were anxious to join the school.

Of course the great attraction was Agassiz, who lectured every day of the week, except Saturday. The girls' parents often came with them, and sat down in the schoolroom to listen to the lectures, which were so clear and so entertaining, that every one followed, with the greatest attention, the subjects brought up by their great teacher, however difficult they might be. But it must be said that, although the school continued eight years, and the number of pupils who passed through it was quite large, — about five hundred, — not a single one of them became a naturalist, or even an "amateur" in natural history. The only female pupil Agassiz made in all his life was his second wife; and even she gave up her studies in this line after his death, showing that it was not through inclination and special taste that she had become a naturalist, but only through her husband's inspiration.

The money brought in by the school was a great help and a great relief. As Mrs. Agassiz says, "He was never again involved in the pecuniary anxieties of his earlier career." [1] However, it must not be supposed that from the day he opened his school for girls he had no further money difficulties. It was impossible for a man of his nature to keep free from such difficulties. As long as he lived, he was constantly hunting after a dollar to pay some expense he had already incurred.

[1] "Louis Agassiz," by Mrs. E. C. Agassiz, Vol. II., p. 527.

On the whole, the school for girls was a most successful undertaking, which reflected great credit on the leadership of Mrs. Agassiz, and on the practical turn of mind shown by Alexander Agassiz and Miss Ida.

CHAPTER XVI.

1856–1858.

"Contributions to the Natural History of the United States" — Its Importance as a Scientific Work and its Popularity in America — Special Reprint in England, and French Translation of his "Essay on Classification" — Offers of Dr. Oswald Heer — Invitation to accept the Chair of Palæontology in the Jardin des Plantes of Paris — Geographical Distribution of Fresh-Water Fishes of the United States.

Under the direction of Mr. Francis C. Gray, of Boston, a most generous and constant friend of Agassiz, the editorship of an important and costly work on the natural history of North America was undertaken. A subscription list was started as soon as the prospectus was issued, in the autumn of 1855, and, to the astonishment and great delight of Agassiz, quickly reached the unexpected number of twenty-five hundred subscribers, the necessary number suggested by the publisher, to insure the success of the publication, being five hundred. The subscription price was twelve dollars per volume, and there were to be ten volumes, each volume being entirely independent, except the first two, which were combined in such a manner that they formed a whole. The first two volumes were issued in April, 1858; two more volumes appeared in

1860 and 1862; and then the work was interrupted, and never resumed.

The large number of subscribers to such a costly and special publication proves the great popularity attained by Agassiz during the first eight years of his stay in America. He had succeeded in exciting an interest in questions of natural history, until then much neglected, not only as a special pursuit, but as a part of the general education of the people at large. The citizens liberally showed their interest in the undertaking, not only because they thought that the subject was worthy, but also to reward a naturalist of world renown, whom they wanted to attach more and more to themselves, and persuade to make America his home and adopted country. This explains both the success of the subscription, and the following optimistic sentences in the preface of Volume I.: "I must beg my European readers to remember that this work is written in America, and more especially for America; and that the community to which it is particularly addressed has very different wants from those of the reading public in Europe. There is not a class of learned men here, distinct from the other cultivated members of the community. On the contrary, so general is the desire for knowledge, that I expect to see my book read by operatives, by fishermen, by farmers, quite as extensively as by the students in our colleges, or by the learned professions; and it is but proper that I should endeavour to make myself understood by all" ("Contributions Natural History of the United States," Vol. I., Preface, p. x).

His expectation proved a Utopian dream; for, except Part I., "Essay on Classification," all the other memoirs, — on the "Turtles," on the "Acalephs," on the "Radiata," — are so special, that only very few persons were able to read them with anything approaching a general understanding, and fewer still, to follow the minute descriptions. It is no exaggeration to say that the number of persons in America who read this great work, except the "Essay on Classification," was limited to less than one hundred; and that the specialists in Europe interested in the subjects treated numbered only a few dozens. However, it should be said that these memoirs are worthy of Agassiz's great reputation as a naturalist, and have added many new facts in regard to the Testudinata and Acalephs. The figures on the plates are all excellent, and show beyond question that natural history specimens and details of the most delicate anatomical structures were treated in a style which was never surpassed and rarely equalled in Europe.

Part I., "Essay on Classification," was read by many. To say that it was understood, in all its meaning and far-reaching generalities, would be wide of the mark. It requires a profound and vast knowledge of natural history enjoyed by few naturalists to understand such a philosophical work, which is in fact a *résumé* of the discoveries of all observers since Linnæus and Cuvier.

A special octavo edition of the "Essay" was reprinted in England, and a French translation in Paris. It is the work of the mature age of Cuvier's best pupil, and is by far the most important contribution of Agas-

siz to natural history during his life in America. It contains the last great discovery he made; namely, that "the changes which animals undergo during their embryonic growth coincide with the order of succession of the fossils of the same type in past geological ages."

If the influence exerted by the "Essay" was not so great as it should have been, it was due to adverse circumstances which it was impossible to foresee and prevent. During his stay in Europe, Agassiz's researches were mainly palæontologic, with the study of glaciers as a sort of recreation. His true zoölogical studies were confined to fresh-water fishes, and even these studies he did not carry very far. In America, on the contrary, he devoted almost all his time to zoölogy and to embryologic researches, almost entirely abandoning palæontology and glaciers; and it required ten years of hard and continuous work, mainly with the microscope, to enable him to master the purely zoölogical part of living animals, and explain its harmony with the palæontology. It is not just to reproach him, as has sometimes been done, with the fact that his work on classification came too late by ten years; for it was impossible for him to collect sooner the immense quantity of materials required, though, of course, if it had been published ten years earlier, it would have exerted a greater influence on his contemporaries.

On the other hand, the publication of Darwin's "Origin of Species," only two years after the issue of Agassiz's "Essay on Classification," distracted the attention of a certain number of savants, who seized this opportunity to discuss and checkmate the theory of

diversity of creations, admitted and propagated by Cuvier's school. The great misfortune of Agassiz's "Essay" was that it came at an inopportune moment. It was too late to do all the good that it ought to have done; and too soon, because of the discussion and passionate polemic raised by Darwin. If Agassiz had waited three years longer, he would have given another shape to his great generalization, and presented well-digested views in opposition to the Lamarckian system revived by Darwin. It is to be regretted that Agassiz entered into personal encounters at meetings of academies and scientific societies, for, not being a good debater like Cuvier, he failed to present the best part of his argument; whereas, if in the calm of his library, he had marshalled all his facts against natural selection, the survival of the fittest, etc., he would have exerted a very beneficial influence in the sort of unreasonable allurement which induced a large number of semi-savants to enter the path reopened by Darwin, to the conquest of the creation and the Creator.

As it is, however, Agassiz's "Essay" is a great work, and will remain in the history of classification. Pecuniarially, also, it was a great success for both Agassiz and the publishers.

The issue of the first two volumes almost coincide with the anniversary of his fiftieth birthday. At least on that day, the 27th of May, 1857, the manuscript was so far advanced, that he might justly have felt that he had attained the end of his task. While hard at work, at his library desk, as the clock struck twelve, musicians stationed in front of his house began a serenade which

was followed by congratulations of friends and special students. It was for this occasion that his colleague and friend, Longfellow, composed the following verses: —

THE FIFTIETH BIRTHDAY OF AGASSIZ.

It was fifty years ago.
In the pleasant month of May,
In the beautiful Pays de Vaud,
A child in its cradle lay.

And Nature, the old nurse, took
The child upon her knee,
Saying: "Here is a story-book
Thy Father has written for thee.

"Come wander with me," she said,
"Into regions yet untrod;
And read what is still unread
In the manuscripts of God."

And he wandered away and away
With Nature, the dear old nurse,
Who sang to him night and day
The rhymes of the universe.

And whenever the way seemed long,
Or his heart began to fail,
She would sing a more wonderful song,
Or tell a more marvellous tale.

So she keeps him still a child,
And will not let him go,
Though at times his heart beats wild
For the beautiful Pays de Vaud, —

Though at times he hears in his dreams
The Ranz des Vaches of old,
And the rush of mountain streams
From glaciers clear and cold;

And the mother at home says, "Hark!
For his voice I listen and yearn;
It is growing late and dark,
And my boy does not return!"

May 28, 1857.

When Switzerland founded a federal polytechnic school, as a sort of compromise for a state university, Agassiz was written to, unofficially, in regard to an appointment. The friend who sent the message, the learned Oswald Heer, wrote first to call Agassiz's attention to the advantages to be derived from a position among his old friends, some of them his classmates also, as Arnold Escher de la Linth, Albert Mousson, and his first teacher in zoölogy, the old Schink, who was still living at Zürich; and second, at the same time, to offer to sell Agassiz his own private collection of Oeningen fossils, knowing well how easily he was tempted by collections. But Agassiz, in a letter dated January, 1855, declined both offers, at the same time asking for Glaris fossils fishes, if Heer was able to procure any, and saying that as soon as he had money at his command, he would with pleasure purchase his collection of Oeningen fossils, which he was enabled to do five years later.

But a much more tempting offer was made in August, 1857, when Agassiz received the following official letter:

PARIS, le 19 août, 1857.

Monsieur, — Une chaire de paléontologie est vacante au Muséum d'Histoire Naturelle de Paris. Vous êtes Français, vous avez enrichi votre pays natal de travaux éminents et de recherches laborieuses; vous êtes membre correspondant de l'Institut. L'Empereur serait heureux de ramener en France un savant distingué, un pro-

fesseur renommé. Je viens vous offrir en son nom la chaire vacante et votre patrie se félicitera de retrouver un de ses enfants les plus dévoués à la science.

Veuillez agréer, Monsieur, l'assurance de mes sentiments de haute estime.

ROULAND.

The Museum of Natural History or Jardin des Plantes had just passed through a great crisis. Its organization needed a complete reform; but two successive committees, appointed in 1849 and in 1858, to report on the condition and improvements to be introduced, in order to end the existing anarchy, had most pitifully failed to do anything, owing to the factious opposition of the professors, who were at the same time administrators of that great establishment. The Emperor and his ministry were well acquainted with the difficulties, owing to information obtained from a naturalist of talent, Prince of Canino, Charles Lucien Bonaparte, who was mentioned by Napoleon III. for the directorship, with power to form a new organization and to put into operation all the needed reforms to keep the establishment on a level with foreign institutions of the same sort, or even at their head, as it had been during the time of Cuvier, Lamarck, Geoffroy Saint-Hilaire, Lacépède, Desfontaines, etc.

Prince Charles Lucien Bonaparte had spoken to his cousin, the Emperor, of the great value of Agassiz; he had always maintained intercourse with him, ever since they had proposed a joint expedition to the United States in 1842, and he relied much on Agassiz to reform the Jardin des Plantes; but his death in 1857, at the premature age of fifty-four, put an end to the scheme.

The French government, however, resolved to adopt his views of reform, and the Secretary of Public Instruction wrote the preceding letter, hoping that Agassiz would accept and accomplish the complete reorganization so much needed in the Museum of Natural History.

But it was too late; the French government had twice missed its opportunity. The offer should have been made in 1846, when Agassiz was in Paris, poor and anxious as to his future; or even in 1853, on his return from Charleston, after the serious illness which endangered his life. Now, after the great success of his school for girls, of the subscription to his great work on the natural history of North America, with brilliant prospects for the foundation of a great museum, which should be entirely his own, and with the strong family ties resulting from his second marriage, it was out of the question for him to return to Europe and begin life a third time, however attractive the offer and prospect might be.

After long and deliberate consideration, Agassiz declined, in the following letter to M. Rouland: —

À Son Excellence le Ministre de l'Instruction Publique et des Cultes, à Paris.

Monsieur le Ministre, — Après avoir passé la plus grande partie de ma vie éloigné des grands centres scientifiques, je ne me serais jamais attendu à recevoir l'honneur très distingué que vous m'avez fait, en m'offrant au nom de l'Empereur, la chaire de Paléontologie au Muséum d'Histoire Naturelle de Paris.

Le monde entier regarde le Jardin des Plantes comme l'établissement le plus important qui existe pour les sciences naturelles. Aussi ai-je lu votre lettre avec le plus grand plaisir, et en recevant votre offre j'ai eu la preuve, bien précieuse pour moi, que je n'étais

pas oublié en Europe. Malheureusement je me trouve dans l'incapacité d'accepter votre proposition, car il m'est impossible de trancher brusquement les liens que depuis plusieurs années je me suis habitué à considérer comme m'attachant aux États-Unis pour le reste de mes jours. Comme je ne puis supposer que l'enseignement qui était confié à M. d'Orbigny puisse être interrompu assez longtemps pour me permettre de finir les travaux embryologiques que j'ai entrepris en vue d'établir des comparaisons avec les fossiles des époques antérieures à la nôtre, travaux qui perdraient tout leur intérêt si je les laissais inachevés, je me trouve ainsi placé dans la pénible nécessité de refuser une position que, dans toutes les circonstances, je regarderai toujours comme la plus brillante à laquelle un naturaliste puisse aspirer.

Il peut vous paraître étrange que je laisse quelques ovaires et embryons peser dans la balance qui doit décider du reste de ma vie ; mais c'est sans aucun doute à ce dévouement absolu à l'étude de la nature que je dois la confiance dont vous venez de me donner une marque aussi éclatante qu'inattendue ; et c'est précisément parce que je désire de continuer à la mériter dans l'avenir, que j'ai pris la liberté d'entrer dans ces détails.

Permettez-moi aussi de rectifier une erreur qui circule sur moi. Je ne suis pas Français. Quoique d'origine française, ma famille a été Suisse depuis des siècles ; et moi-même, malgré une expatriation qui dure depuis plus de dix années, je n'ai pas cessé d'être Suisse.

Je demande à Votre Excellence de recevoir, avec le renouvellement de mes regrets sincères de ne pouvoir accepter la chaire que vous m'offrez, l'assurance de ma considération la plus distinguée.

LOUIS AGASSIZ,
Professeur à l'Université de Cambridge
(*États-Unis d'Amérique*).

CAMBRIDGE, le 25 septembre, 1857.

M. Rouland was so desirous of securing Agassiz's services that he did not accept this refusal as final, but wrote him again, saying that he would let his offer stand for two years, in order to allow him to finish his

most important works in America; and it was not until Agassiz's personal visit to him at Paris, in July, 1859, during which the Secretary of Public Instructions explained to him that the chair of palæontology was only a pretext to bring him to France, that he accepted his decision as final. He intimated to him that he would have the directorship of the Museum of Natural History, — an office to be created, — very likely another chair at the Collége de France, as Cuvier had, and finally a senatorship, with salaries amounting to not far from fifteen thousand dollars, — an offer brilliant, both as to rank and remuneration.

But it was all in vain. Agassiz's refusal was final. The French government behaved nobly, taking the refusal in good part, and continuing to consult him on questions of acclimatization of marine animals, and sending him, in succession, the cross of a Knight of the Legion of Honour and of an officer of the same order. In brief, it may be said that Agassiz received from France more tangible proofs of the great esteem in which he was held than from any other European country. He was first elected correspondent,[1] afterward foreign associate fellow (Membre associé étranger) of the Academy of Science of the Institute, a rare and much-valued distinction. He received a Monthyon prize of Physiology and the Cuvier prize from the same academy, was offered officially the chair of palæontology at the Jardin des

[1] Agassiz was elected a corresponding member of the Academy of Science of France as far back as April, 1839, when he was barely thirty-two years old. His concurrent was Prince Canino, the son of Lucien Bonaparte, and the election was very close.

Plantes, and was created Knight and officer of the Legion of Honour. In 1870–1871, when France was in trouble and suffering such crushing defeats, although mainly through her own fault, Agassiz came forward, and expressed his great disapproval of the brutal conduct of the victorious Prussians, fully realizing the debt the present civilization and political freedom in Europe owed to the many good acts and the intervention of France in behalf of progress. Indeed, without the help offered so generously to Switzerland, in 1857, his own canton of Neuchâtel, of which he was a burgess (Bourgeois de Neuchâtel et de Valengin), would have remained to this day under the rule of the king of Prussia. Although Agassiz shrank all his life from politics, he was very liberal, and always in favour of liberty.

One of Agassiz's first schemes when he came to the New World was the preparation of a great work on the fresh-water fishes, analogous to the one he had attempted in Europe on the same subject. He soon discovered that the best man to associate with him to carry out his intentions was Dr. Spencer F. Baird, then a young professor at Carlisle, Pennsylvania. Baird entered with great enthusiasm into all the views and ideas of Agassiz, explained to him during a prolonged visit to Cambridge in May and June, 1848; and after an understanding in regard to the number of specimens to be collected and their geographical distribution, he started to explore Lake Champlain. Baird succeeded, but he did one thing which he had not anticipated. He made the acquaintance, at Burlington, of Senator George P. Marsh of Ver-

mont, one of the regents and a member of the executive committee of the Smithsonian Institution, who was so impressed by the knowledge, modest bearing, and industry of the young ichthyologist that he proposed him as assistant director of the new institution. After some years of dilatoriness and continuous postponement, really due to want of time, Baird saw that it was idle to expect the realization of Agassiz's scheme, and abandoned it altogether. Agassiz, however, was too much of a fish-lover not to be constantly reminded that a great work was in reserve for him; and during his journey up the Mississippi from New Orleans to St. Louis in 1853, he was much struck by the differences of fishes, according to difference of latitude, in that long north-south watercourse, and in accordance with a habit formed at that time, and practised constantly afterward, he printed a circular asking for information and for collections, which was distributed largely all along the courses of the rivers and on the coasts of the Lakes. Answers came by dozens, and collections followed one another, until Agassiz had ichthyological treasures to his heart's content. But time to co-ordinate and make use of all these facts and specimens was lacking, and one scheme after another constantly postponed the promised study of the distribution and localization of the fresh-water fishes of the United States. Only a few short papers were published on "Extraordinary Fishes from California," on "Fishes from the Southern Bend of the Tennessee River, Alabama," while some of his letters on the subject have appeared in Mrs. Agassiz's life of her husband; but this is all.

CHAPTER XVII.

1858–1864.

Visit to Europe — Reunion of Swiss Naturalists at Pictet's Country House to meet him — Agassiz Museum — Inauguration of Part of the North Wing of the Building — New Series of Pupils — Money Difficulties in Connection with the Museum — Lectures and Lessons at the Museum — Secession of Several of his Pupils.

In June, 1859, Agassiz, in company with his wife and youngest daughter, left for Europe. He wished to see his old mother, and to present his American wife to her and to all the members of his Swiss and German families. On his way to Switzerland, he lingered a few days in the British Isles to see his old friends, the Earl of Enniskillen and Sir Philip Egerton, the two most distinguished palæoichthyologists of Great Britain and Ireland; Richard Owen, at Richmond Park, near London; and Roderick Murchison, who invited all the naturalists then in London to meet him at his fine house in the fashionable and aristocratic West End.

At Paris a week quickly passed among Agassiz's old friends, the French savants; and he had long conversations with the Secretary of Public Instruction, M. Rouland, on all sorts of questions relating to natural

history establishments and organizations. Although most cordially received by the French naturalists, Agassiz easily perceived the presence of a fear that he would accept M. Rouland's previous offers; but he foresaw too many difficulties to yield even to such a tempting proposal. As he said afterward, it would have been impossible to reform anything at the Jardin des Plantes, without deeply and irremediably wounding his friends, Valenciennes, Henry Milne-Edwards, Decaisne, and others. When they knew his final refusal, it was a great relief to them all, and their pleasure in his visit was increased a hundred fold.

His return to Switzerland gave immense pleasure to Agassiz, who, like a true Swiss boy, shed tears when he again beheld the Alps. His distinguished mother was enraptured to see her favourite child again, and the few weeks they spent together passed like a dream for her. Agassiz spent most of his time in her company at the beautiful country house of her eldest daughter, Mrs. Cécile Wagnon, at Montagny, between Yverdun and Grandson, "au beau Pays de Vaud"; and, on seeing them together, it was most evident, as one of the family told me a short time afterward, that the great attractiveness possessed by Agassiz was a gift from his mother. They spent most of their time in the "buvette," a sort of out-of-door sitting-room in the garden; and there, with the great panorama of the Alps in the distance, and back of him the Aiguilles de Baulmes and the Suchet, two of the old Jura mountains where he used to hunt for plants, boulders, and traces of old glaciers, Agassiz passed a summer of repose and

true happiness. He visited at Lausanne his younger sister, Mrs. Olympe Francillon, and other family relations.

The Italian war, then raging, had much disturbed all Switzerland. The Helvetic Society of Natural Sciences, which met every year in some part of the Swiss Confederation, was to have had its session at Lugano, in Tessino, close by the boundary line of Italy. On account of the war, the meeting was postponed to the next year; but the arrival of Agassiz, and also the sudden conclusion of peace between France and Austria, gave another turn to affairs. It was too late for a regular call of the Helvetic Society; but Pictet had the happy thought of asking the "Société de Physique et d'Histoire Naturelle de Genève," to take upon itself the calling of an extraordinary meeting of the Helvetic Society of the Natural Sciences, in order to allow the numerous scientific friends of Agassiz, scattered all over Switzerland, to meet and shake hands with him. First of all, Pictet asked permission of Agassiz, who answered at once:—

MONTAGNY (VAUD), 17 août, 1859.

Mon cher ami, — J'arrive de Neuchâtel et je n'ai que cinq minutes pour répondre à votre charmante lettre, avant le départ du courrier d'aujourd'hui. Je suis enchanté de vos arrangements, et je préfère infiniment que la réunion ait lieu à Genève plutôt que partout ailleurs. J'accepte avec reconnaissance votre aimable invitation pour ma femme et pour moi, et vous pouvez compter que je serai à Genthod [the splendid country house of Pictet] mardi, pour peu qu'il me reste un souffle de vie. Mille remerciements à Madame Pictet pour le bon acceuil qu'elle promet à ma femme.

Mes amitiés les plus cordials à tous nos amis communs de Genève.

Bien à vous,

LS. AGASSIZ.

The Swiss naturalists gathered promptly at Geneva and the Helvetic Society met the 24th and 25th of August in one of the halls of the Conservatory of Music. All Agassiz's old friends came in force; among them, Peter Merian of Bâle, the Nestor of Swiss geologists; Escher von der Linth of Zürich, a classmate and personal friend, and one of the first converts to the glacial theory; Bernard Studer of Berne, the explorer of the geology of the Oberland, Monte Rosa, and Grand St. Bernard; Louis de Coulon of Neuchâtel, the constant friend of Agassiz, etc., etc.; besides foreign savants of note, Tyndall and Frankland of England, Henry St. Clair Deville of Paris, and others.

The interest concentrated on the communications of Agassiz. On the first day he treated, with more than his usual brilliancy, a general question of natural history: "Toutes les grandes divisions du règne animal, telles qu'elles ont été établies par Cuvier, sont avec quelques modifications, fondées sur des bases naturelles tenant à un plan commun et non sur des bases plus ou moins artificielles," and on the second day he communicated his observations on the Acalephs, and the present formation of coral reefs on the Florida coasts in connection with an explanation of some oölitic strata of the Jura Corallian.

All the Swiss naturalists were loud in their congratulations. It was such a treat to hear again the voice of one who had made such a sensation, first at Neuchâtel in 1837, and afterwards at Porrentruy in 1838, on the subject of the glacial age and the present glaciers.

Tyndall was among the most enthusiastic, and it was a rare sight to see such savants as Jules Pictet de la Rive, Auguste de la Rive, Plantamour, A. de Candolle, A. Favre, Escher, Studer, Merian, Heer, Mousson, Dufour, Vouga, crowding round and complimenting Agassiz.

Pictet, with his usual desire to conciliate, and with the best intention, arranged, at a great party he gave Agassiz at his country seat at Genthod, a sort of accidental meeting between him and Desor; and in order to succeed in the conciliatory rôle he had undertaken, without the approbation or even knowledge of Agassiz, he tried to bring Karl Vogt to Genthod. But Vogt, who was always honest in his dealing with others, if rough and sometimes in the wrong, and who was adverse to scenes, declined to be one of the party. Agassiz was somewhat painfully impressed by the meeting, tears were shed, but, as Vogt says in his biography of Desor, no change of any sort was effected, and things remained as they were after the separation at East Boston in the spring of 1848.

Agassiz also paid a short visit to the home of his cousin, Auguste Mayor, in Neuchâtel. Although almost all the Neuchâtel families were at their summer places, they came to meet him, and he had an opportunity to see the strong feeling of friendship and admiration which all the inhabitants felt toward him. From Neuchâtel he went to Germany to visit the Braun family. His brother-in-law, Alexander Braun, had removed from Freiburg-im-Breisgau to Berlin, in 1851, and as Agassiz had not time enough at his disposal

to go so far as Berlin, Alexander arranged with his brother Max to meet Agassiz at Aix-la-Chapelle, and from there to go with the whole party for a two-days visit at the house of Max Braun, who was director of the mines at La Vielle Montagne, near Moresnet, Belgium. It was a meeting of congratulation on every side, and Mrs. Agassiz and Pauline were objects of great interest to the two brothers. They found Agassiz the same enthusiast, full of new schemes for the progress of natural history, and they were delighted to learn his success in the foundation of a new museum at Cambridge. The moment of separation, which all realized meant a final farewell, came only too soon, and Agassiz left for Ostende, London, and Liverpool, whence he sailed the 10th September for Boston.

Agassiz took advantage of his stay in Europe to purchase palæontological collections for his new museum. He succeeded in obtaining the excellent collection of his old teacher at the University of Heidelberg, Professor Bronn, of which he had made use when a student there. While in Switzerland he secured collections from the rich cretaceous localities of Ste. Croix, Canton de Vaud, of Oeningen and Glaris, and in England he bought splendid Jurassic fossils from the vicinity of Weymouth and Lyme Regis. But it was at Lièges in Belgium that he made the most important purchase, the great collection and the no less great library of Professor L. G. de Koninck, the author of many monographs on the carboniferous fossils. However, the bargain with de Koninck was not concluded until more than a year later.

The contemplated visit to the Aar glacier and to see the ruins of the first "Hôtel des Neuchâtelois" on the moraine was postponed. It was rather a disappointment to Mrs. Agassiz, who was always ready to yield to her husband's wishes. Although Agassiz travelled a great deal after 1859, and Mrs. Agassiz always accompanied him, they did not pay a second visit to Europe, and since the death of her husband she has not revisited Switzerland.[1]

At the end of September Agassiz returned to Cambridge, determined to spend his life in America, and at the same time to consecrate all his energy and ability to the creation of a great museum, according to his own views of natural history, and, as he said to his most intimate friends, "the best arranged and the most perfect in the world"; for in the case of Agassiz we may apply Sydney Smith's aphorism, that "Merit and Modesty have no other connection, except in their first letter."

On the 14th of June, 1859, before leaving for Europe, he had laid the corner-stone of his future great museum, with appropriate ceremonies. It had always been the custom of Agassiz to start any scheme having to do with natural history, whether publications or researches, without thought of the necessary means to carry it out, always confident that the future would provide the money required. He followed the same plan with his museum. He found, on entering upon his duties as professor of zoölogy and geology in the Lawrence

[1] Lately — November, 1894 — Mrs. Agassiz left America with Mrs. Pauline Shaw, to pass the winter in Italy.

Scientific School of Harvard University, that there were no collections in Cambridge with which to illustrate lectures upon geology and zoölogy, and that no provision had been made to obtain such collections by purchase or otherwise. Therefore, from the first day of his arrival at Cambridge, he was incessantly planning and continually adding to his private collection, sure that although not a dollar had been provided yet, and no suitable place existed, building and money would come. He himself was heavily in debt, and in addition had to provide for the daily expenses of a numerous and complicated household. Never did a man display such an amount of skilful diplomacy, — not diplomacy of the ordinary kind but natural history diplomacy, peculiar to the man, as well as peculiar to the end he wanted to attain. No one else could have succeeded, no corporation however strong and influential could have executed the plan he conceived alone and carried out alone, against all odds and constant difficulties. He never despaired of final success, although he sometimes became despondent, under pressure of illness, or of political troubles, or of dissensions among his assistants and pupils. What courage! Never was there such a valiant promoter of the progress of natural history.

The first money which came to him was the twelve thousand dollars mentioned before, raised by private subscription under the initiation and direction of the treasurer of Harvard University, Mr. Samuel Eliot, the distinguished father of the present President of the University. Then, in 1858, Mr. Francis C. Gray of

Boston left a bequest of fifty thousand dollars for the purpose of establishing and maintaining a museum of comparative zoölogy. State aid was necessary; but the question was how to get it in a commonwealth celebrated for its careful management of public money. The majority of the members of the Massachusetts Legislature are farmers, very difficult to interest in anything not directly profitable; and how to persuade them to lend the pecuniary help of the state to a purely scientific establishment, to the exclusion of similar institutions for educational purposes scattered through the state, was a problem not easy to solve; and now, more than at any other period of his eventful life, Agassiz showed of what solid metal he was made.

He first enrolled the governor of Massachusetts under his banner; then the State Committee on Education was carefully approached on general principles of public instruction, and the advantages to be derived by the farmers from a knowledge of everything relating to pests of all sorts, the best breeds of domestic animals, and kindred matters, and Agassiz obtained, by skilful manœuvring, an invitation to address the Committee on the subject. His success was now assured. What he wanted was to be brought before the Legislature; for, after privately interesting the governor and the lieutenant-governor, and the Committee on Education, he attacked the President of the Senate, the Speaker of the House of Representatives, the Secretary of the Board of Education, and the Chief Justice of the Supreme Judicial Court. In fact, the Legislature was captured, and voted that aid should be granted to the extent of

one hundred thousand dollars. Another sum, of seventy-one thousand dollars, was also raised among the citizens of Boston for the purpose of erecting a fireproof building to receive and exhibit the collections, for which Harvard College gave a piece of land, and Agassiz offered a plan. The plan was on a grand scale; the building was to be in the form of a great rectangle open on the eastern side, the main part 364 feet in length by 64 feet in width on the western side, with wings 205 feet in length and 64 feet in width. It was impossible to erect such an immense fireproof structure with the means at his disposal, and Agassiz contented himself with building, for the present, only two-fifths of the north wing. We shall see further on how his plan was carried out, with great modifications, if not in the building at least in the purpose to which almost two-thirds of it were devoted.

In December, 1859, the condition of the north wing was sufficiently advanced to allow the beginning of the removal of the collections from the wooden house, near the chemical laboratory of the Scientific School, and, in May, 1860, the building was completed, all the collections removed, and the wooden house also changed its place and purpose, being moved opposite the north wing of the great museum and placed on the ground on which the south wing was to be built later, and which is now occupied by the Peabody Museum of Ethnography. This small house was completely refitted and arranged as a sort of boarding-house, called the Zoölogical Hall, for the use only of assistants and students of the Museum. It was a kind of third "Hôtel des Neuchâtelois," con-

ducted largely on the plan of the Pavillon Dolfuss of the glacier of the Aar. Besides the artist Burkhardt, F. W. Putnam, assistant in care of the fishes, was located there, and also successively the following students: A. Hyatt, N. S. Shaler, A. Ordway, A. E. Verrill, A. S. Bickmore, J. A. Allen, E. S. Morse, and William H. Niles.

On November 13, 1860, the inauguration of the Museum took place in the presence of the governor and his staff and escort of Lancers, and addresses were made by Governor Banks, President Felton of Harvard University, Dr. Jacob Bigelow, the chairman of the Building Committee, and Professor Agassiz. It was a happy day for the professor, and a well-deserved reward for his Herculean exertions since his arrival in the New World fourteen years previously.

Of course everything at first was in confusion. Boxes, empty or full of specimens, were piled up in all directions in the workrooms. The great library purchased from de Koninck lay on the floor in complete disorder. The labourers employed were limited to an infirm Irishman, who had great difficulty in walking, and another man absolutely inexperienced in moving specimens. Besides the cellars and attics in which were stored the collections kept in alcohol and in drawers, there were, on the first floor, four halls for the lecture room, the workrooms, and library, and on the second floor four more halls in which the collections for the public were displayed. The classification was zoölogical at first; and each assistant and pupil was assigned to a special class of animals living and fossil. Afterward the animals

were divided, the fossils being in charge of special assistants, and the living animals in charge of others. To the general zoölogical classification was added what Agassiz called his "synoptic room," a sort of epitome of the whole creation, and later fauna of special geographic divisions. He even asked me to have, in a "palæontologic room," a résumé of the succession of fauna during the geological periods. After submitting a plan, which I have published since in my volume, "La Science en France," Paris, 1868, he was so enthusiastic about my plans that he wanted at once to put them in operation; but there was no room large enough, and to build a special hall for the purpose was too costly, and impossible at that moment.

His energy was constantly directed to innovations. Before the arrangement was made for a new placing and classification of the specimens on exhibition, he changed his plan; and this happened with him every three or four months. It was impossible to keep pace with his tremendous activity and his constant changes.

Agassiz himself was so busy that after passing from place to place, where his assistants and pupils were working, giving advice and directions, or announcing the arrival of new specimens, no time was left to him to do anything else; for every afternoon he was obliged to spend in Boston in the committee rooms of the General Court to push his claims for an annual appropriation for his Museum. Nevertheless, an immense amount of work was done every day. Each one worked with a will, for the impulse given by Agassiz was sufficient to keep every one busy.

With the opening of the Museum came a new series of pupils. Of the old ones only four remained, — Alexander Agassiz, Theodore Lyman, H. J. Clark, and F. W. Putnam. Alexander Agassiz had charge of all the specimens kept in alcohol, of the exchanges, and the business management of the Museum, — by no means a sinecure. Henry J. Clark had been appointed adjunct professor of zoölogy, and his time was mainly occupied by his lectures and his microscopic embryological studies. F. W. Putnam was in charge of the collection of fishes and vertebrates, and Theodore Lyman worked at the Ophiuridæ.

The new set of pupils were remarkable for their almost complete ignorance, not only of what a museum of natural history is, but also of natural history itself. To be sure, they all had a great desire to learn, and to become naturalists, but they had not enough experience to make them efficient as assistants in the work to which they were specially detailed. On the whole, the personnel of the institution was rather crude; and the collections which came from every corner of the world became much confused, some being determined and well labelled, others having no labels at all or very inadequate indications. No catalogue of any sort existed, and over all there was a mind oscillating and hesitating as regards classification; for almost every three months, during the first four years of the existence of the Museum, some new idea was put forward by Agassiz, which altered and more or less changed what he had already proclaimed as a definite and immutable classification.

From the beginning, Agassiz adopted a very questionable method of giving his directions and instructions for the arrangement of the Museum, by calling together all his assistants and pupils into the lecture room, and there making known his plans for organization, rearrangement, classification, method, etc., explaining everything at great length and with great force. Naturally every one applauded; and Agassiz came away from each of those numerous meetings convinced that his new directions and reforms were well understood, and that they would be put directly into operation and soon executed. Instead of giving orders, Agassiz, with great *naïveté*, tried to convince. The result may be easily imagined. Every assistant and pupil after the delivery of the address, — for it was nothing more nor less than one of the usual speeches of the director, — returned to his place in the laboratories, and continued to study the work he was engaged upon, without once thinking of the advice and fresh directions just heard. They felt a sort of inertia, which finally irritated Agassiz, who did not understand why his clear directions and instructions were not better followed. At times he was inclined to think that it was due to the too independent American character; at other times, to ill-nature and even to conspiracies among his young pupils and assistants. The teaching of Agassiz was unique, but the organization of the Museum was rather deficient; for the pupils, outside of their studies, had no time to arrange collections, and besides, they did not know how to proceed. On the whole, there was considerable confusion, but no anarchy, thanks to the help and generous

services constantly rendered by the friends of Agassiz, who, solely to please him, gave a great part of their time, without compensation, and often even expended liberally their own money to promote the progress of the infant establishment.

I may mention more especially the constant and generous help of Mr. James M. Barnard, an old pupil of Agassiz, who devoted a great deal of his time to the Museum, increasing its collections, working at some of them, subscribing largely to the funds of the Museum, and finally taking in hand the numerous unsold volumes and memoirs of Agassiz's works published in Switzerland, and disposing of them to the best pecuniary interest of their author. From 1855 to 1865, a period when he was always hard pressed, Mr. Barnard rendered Agassiz the greatest service in his money affairs, thus saving him from much trouble and nervous wear. To him also belongs the credit of being the prime mover and the treasurer of the Agassiz Memorial Teachers' and Pupils' Fund raised in 1874, after the death of Agassiz.

Agassiz was so earnest that it was a pleasure to help him and to increase the collections of his Museum. He was almost irresistible when he begged some favour or some beautiful and rare specimen. In the early summer of 1860, on my return from an absence of six years in Europe, I found that my friend Agassiz had much altered in his appearance and in his capacity for original study. As a teacher, he was as brilliant as ever; and as a collector of specimens, he was even more zealous than he had been; for having now a museum of his

own, he was ambitious to fill it to its utmost capacity with all the best and rarest specimens he could obtain. His dangerous sickness at Charleston in the winter of 1853, combined with the great mental exertions involved in the publication of the first two volumes of his "Contributions to the Natural History of America," had told on his strong constitution. After mutual congratulations on meeting again, — for, although very different in character and in our scientific researches, we agreed on many points, and were much devoted to one another, — Agassiz imparted to me, in his naïve way, his desire to have me help him in his difficult undertaking. I saw at once the great disadvantage of creating an establishment on such a large scale, in such an out-of-the-way place as Cambridge; but Agassiz was so sanguine and so optimistic that it would have been cruel to raise objections and to try to open his eyes. It was truly magnificent to see him every year, fighting against difficulties, especially money difficulties, with which no one but he would have dared to contend, and always expending double, sometimes treble, the sum he had on hand. Indeed, to be in debt was his normal condition. He used to say, "Every year has its work to provide pecuniary means for the Museum," and he acted as if he thought he should live forever.

During the winter of 1861, Agassiz, in order to influence the Legislature and government of Massachusetts to make a grant of money, arranged to have the governor and the General Court to visit the Museum. They came in a body, and were shown all over the building, and Mr. Barnard and I were invited to help him receive

them. At his special request, I came to the Museum almost daily during 1861–62, to give advice to several of the pupils,[1] taking them on geological excursions about Boston and Gay Head. Finally, after helping Agassiz gratuitously for two years, some family friends and relations in Boston subscribed a thousand dollars for two years, to defray my travelling expenses, on the condition that I should give to the Agassiz Museum the collection of fossils made during my explorations. In this way I was more or less connected with the Museum during the first four years of its existence, by far its most difficult period; for not only was the building small and crowded, but the space allowed for each specialty was inadequate, the halls were cold and most uncomfortable during the long winters, and it was not easy even to reach the building, on account of the lack of proper sidewalks and roads, through the surrounding marsh.

The lack of money was a difficulty which fettered the development of the Museum from the start. Agassiz had been too precipitate in his purchase of collections in Europe, relying upon the grant of a hundred thousand dollars voted by the Legislature, the payment of which was delayed several years; and when it was received the trustees of the Museum refused to allow the use of the capital, but only the income, — a great disappointment to Agassiz, who was hard pressed for money to pay for his foreign purchases.

[1] Agassiz recommended me more specially Messrs. Alpheus Hyatt and N. S. Shaler, and afterward Messrs. C. Frederick Hartt and Orestes St. John, with the request that I should help them in geology and the use of palæontology in practical stratigraphy.

I shall give one example only to show the sort of difficulty experienced. An old scientific friend, L. Guillaume de Koninck, of Liège, on my suggestion, sold to Agassiz his splendid collection of fossils for five thousand dollars, and his no less valuable library for another five thousand dollars. Collection and library came safely over, and were unpacked during the winter of 1860-1861. But there was no money to pay for them. Agassiz, with his usual confidence, was not in the least embarrassed. "I have the collection and library, at all events," said he, "and de Koninck will have to wait." But the great Civil War came, the price of exchanges rose rapidly and so high that to send the ten thousand dollars to de Koninck would have cost fifteen thousand dollars or even eighteen thousand dollars. De Koninck was in distress, and wrote me under the date of the 19th of December, 1862: —

J'ai toute confiance en M. Agassiz, et je crois suffisamment le lui avoir montré en lui expédiant le tout, malgré les circonstances défavorables dans les quelles se trouvent les affaires en Amérique. Comme vous avez été en quelque sorte l'intermédiaire dans cette affaire, puisque c'est d'après vos indications que je me suis adressé à votre savant ami, et que par une heureuse coincidence vous vous trouvez actuellement avec lui, vous m'obligeriez infiniment, si vous aviez la bonté de me dire vers quelle époque vous croyez que je pourrai être payé et en combien de versements? Je me suis permis de faire la même demande à M. Agassiz, mais jusqu'ici je n'ai reçu aucune réponse. Je l'ai supplié même de tacher de m'envoyer une dizaine de mille francs avant la nouvelle année, ou au moins immédiatement après, parce que j'en ai un pressant besoin pour satisfaire à des engagements souscrits. Si vous pouviez contribuer en quelque chose à me faire obtenir cette somme, qui au reste

m'est due d'après nos conditions, vous me rendriez une immense service.

Another more pressing letter came soon after, and Agassiz made a settlement, agreeing to pay a yearly interest on the ten thousand dollars until he should be able to pay the whole sum. Of course, all was finally paid, but de Koninck had to wait several years.

Mr. Samuel H. Scudder has given a very good description of Agassiz's method with his students in an article entitled, "In the Laboratory with Agassiz,"[1] by a former pupil, a very clever and charming reminiscence.

Mr. Scudder says: "He asked me . . . whether I wished to study any special branch. . . . I replied that while I wished to be well grounded in all departments of zoölogy, I purposed to devote myself specially to insects.

"'When do you wish to begin?' he asked.

"'Now,' I replied.

"This seemed to please him, and, with an energetic 'Very well,' he reached from a shelf a huge jar of specimens in yellow alcohol.

"'Take this fish,' said he, 'and look at it; we call it a Hæmulon. By and by I will ask you what you have seen.'

"With that he left me, but in a moment returned with explicit instructions as to the care of the object intrusted to me.

"'No man is fit to be a naturalist,' said he, 'who does not know how to take care of specimens.'

". . . Entomology was a cleaner science than ichthyology; but the example of the professor, who had unhesitatingly plunged to the bottom of the jar to produce the fish, was infectious; and though

[1] "Every Saturday," Vol. XVI., pp. 369, 370, April 4, 1874, and "American Poems," several editions, published by Houghton, Mifflin & Co., Cambridge. Also issued separately as a leaflet for the Agassiz fund, by Mr. Barnard.

this alcohol had 'a very ancient and fish-like smell,' I really dared not show any aversion within these sacred precincts, and treated the alcohol as though it were pure water. Still I was conscious of a passing feeling of disappointment, for gazing at a fish did not commend itself to an ardent entomologist.

". . . In ten minutes I had seen all that could be seen in that fish. . . . Half an hour passed, an hour, another hour; the fish began to look loathsome. I turned it over and around; looked it in the face, — ghastly! from behind, beneath, above, sideways, at a three-quarters view, — just as ghastly. I was in despair. At an early hour I concluded that lunch was necessary; so, with infinite relief, the fish was carefully replaced in the jar, and for an hour I was free.

"On my return, I learned that Professor Agassiz had been at the Museum, but had gone, and would not return for several hours. . . . Slowly I drew forth that hideous fish, and, with a feeling of desperation, again looked at it. I might not use a magnifying glass; instruments of all kinds were interdicted. My two hands, my two eyes, and the fish; it seemed a most limited field. . . . At last a happy thought struck me — I would draw the fish; and now, with surprise, I began to discover new features in the creature. Just then the professor returned.

"'That is right,' said he; 'a pencil is one of the best eyes. I am glad to notice, too, that you keep your specimen wet and your bottle corked.'

"With these encouraging words, he added: —

"'Well, what is it like?'

"He listened attentively to my brief rehearsal of the structure of parts whose names were still unknown to me. . . . When I had finished, he waited as if expecting more, and then, with an air of disappointment, 'You have not looked very carefully; why,' he continued most earnestly, 'you haven't even seen one of the most conspicuous features of the animal, which is as plainly before your eyes as the fish itself. Look again! look again!' and he left me to my misery.

"I was piqued; I was mortified. Still more of that wretched fish! But now I set myself to my task with a will, and discovered

one new thing after another, until I saw how just the professor's criticism had been. The afternoon passed quickly, and when, toward its close, the professor inquired, —

"'Do you see it yet?'

"'No,' I replied, 'I am certain I do not; but I see how little I saw before.'

"'That is next best,' said he earnestly; 'but I won't hear you now; put away your fish and go home; perhaps you will be ready with a better answer in the morning. I will examine you before you look at the fish.'

"This was disconcerting. Not only must I think of my fish all night, studying, without the object before me, what this unknown but most visible feature might be, but also, without reviewing my new discoveries, I must give an exact account of them the next day. I had a bad memory, so I walked home by Charles River in a disturbed state with my two perplexities.

"The cordial greeting from the professor the next morning was reassuring. Here was a man who seemed to be quite as anxious as I that I should see for myself what he saw.

"'Do you perhaps mean,' I asked, 'that the fish has symmetrical sides with paired organs?'

"His thoroughly pleased 'Of course, of course!' repaid the wakeful hours of the previous night. After he had discoursed most happily and enthusiastically — as he always did — upon the importance of this point, I ventured to ask what I should do next.

"'Oh, look at your fish!' he said, and left me again to my own devices. In a little more than an hour he returned and heard my new catalogue.

"'That is good, that is good,' he repeated; 'but that is not all; go on.' And so for three long days he placed that fish before my eyes, forbidding me to look at anything else or to use any artificial aid. 'Look! look! look!' was his repeated injunction.

"This was the best entomological lesson I ever had, — a lesson whose influence has extended to the details of every subsequent study; a legacy that professor has left to me, as he left it to many others, of inestimable value, which we could not buy, with which we cannot part.

"... The fourth day a second fish of the same group was placed beside the first, and I was bidden to point out the resemblances and differences between the two; another and another followed, until the entire family lay before me, and a whole legion of jars covered the table and surrounding shelves. The odour had become a pleasant perfume; and even now the sight of an old six-inch, worm-eaten cork brings fragrant memories.

"... Agassiz's training, in the method of observing facts and their orderly arrangement, was ever accompanied by the urgent exhortation not to be contented with them.

"'Facts are stupid things,' he would say, 'until brought into connection with some general law.'

"At the end of eight months, it was almost with reluctance that I left these friends and turned to insects; but what I had gained by this outside experience has been of greater value than years of later investigation in my favourite group."

Agassiz delivered lectures twice or three times a week before his students. It was the custom at the Museum for every one, assistants, as well as pupils and friends, to attend. His wife was always present, taking notes most faithfully of all that he said. Never was there such a devoted secretary. The numerous public lectures in America, delivered during fifteen years before large audiences, exerted an influence easy to perceive. His explanations were clear, right to the point, never too scientific, and, as far as possible, in untechnical words. But he wanted applause, and even courted it, with great skill. Like an actor on the stage, he would pause at the end of a sentence, in order to allow time for applause. His lectures then and after took more the form of addresses than ordinary expositions of scientific questions. He always interested his audi-

ence to a high degree, but his best teaching was not done in this way. It was too theatrical. Agassiz was at his best when he was looking at specimens, detailing the differences, dwelling strongly on characters which would have escaped other eyes than his own. His unusually keen sight and his rare memory were his great attractions, and he displayed them to the best advantage, on the spur of the moment, when there were only one or two hearers. Then Agassiz was natural, without thought of effect; and he was a wonderful and rare naturalist and incomparable teacher. Like many men of genius, he would seek for admiration and applause, even in dealing with questions, or more correctly with branches, of science, upon which he was not well informed. Trusting to his great ability and immense experience in lecturing, he would go deeply into a subject, not only foreign to his usual researches, but which he had really no inclination to investigate fairly; like the great French painter Ingres, who preferred the approval given to his rather indifferent performance on the violin to that accorded his great and splendid pictures.

Agassiz was not a practical geologist; and when in the field, he showed an almost complete absence of the intuition requisite, indeed absolutely necessary, to master the stratigraphy, the classification, and the orography of any portion of the earth's surface — excepting in regard to glacial questions, on which he was a great master. In his lectures he liked to go into historical geology, in which branch his knowledge was absolutely defective. So long as he kept to generalities, he did

very well; but as soon as he entered into the details of strata, he was weak, wholly lacking in exactness, and uninformed as to geographical geology and the sequence of the numerous groups into which the strata have been divided in each country. If I happened to be present at such lectures, — which was very seldom the case, — Agassiz would look at me in a questioning and imploring way, which said as plainly as words, "Please do not contradict me." Of course I never did.

As a résumé of his unequalled capacities and talents as a teacher, we may repeat what was said of the great French geometer Monge: "Il combinait pour la clareté de ses démonstrations, les regards, les paroles et les gestes. Ses auditeurs craignoient de faire le moindre mouvement dont le bruit put troubler le charme de cette étonnante éloquence."

Unhappily difficulties of another nature than money stringency occurred in the Museum; namely, with the personnel of the establishment. Agassiz never knew how to manage his assistants, and repeated the same faults, with some little variation of details, in his Cambridge Museum, which he had committed previously at Neuchâtel. At first all went smoothly. As a sort of reward, he sent most of his assistants to the Smithsonian Institution at Washington, to study its management and arrange exchanges of specimens. The first difficulty was with Professor Clark, who left the Museum in June, 1863, as we have seen. Then came a sort of revolt among most of his other assistants, which developed slowly during the years 1863 and 1864, and broke out at the begin-

ning of 1865. A regular secession occurred, and five assistants left. One, Mr. Verrill, went to the Smithsonian and afterwards to Yale College; while the others, Messrs. Putnam, Morse, Packard, and Hyatt, retired to Salem, the county seat of Essex County, as a sort of Mount Aventine, where George Peabody, an American banker in London, had given a certain sum of money to the Essex Institute and Peabody Academy of Science. And around these Agassiz's four pupils collected, using them as a base or citadel, from which they expected to conquer the natural history of North America; and for this purpose they started a monthly magazine, "The American Naturalist" and an agency for selling scientific books and papers and for exchanging specimens. After a few years of hard struggle the enterprise failed, notwithstanding their residence among people whom the novelist, W. D. Howells, satirically characterizes as "a little above the salt of the earth." Two were glad to return to Cambridge, one went to Brown University, Providence, while one has remained at Salem, as curator of the Peabody Museum and of the Essex Institute. The whole disagreement was a great mistake on both sides, but more especially on the part of the pupils, who ought to have been more patient with their old professor. The crisis was brought on by new regulations for the assistants of the Museum. Agassiz, with justice, requested that no one connected with the Museum as a regular assistant, or even as a student-assistant, should work for himself in the Museum during the hours fixed for Museum work. He contended that persons were nothing, and that the Museum was

above everything and every one. It was, perhaps, a little too much to expect that young men, who had come there to learn and fit themselves for positions as teachers and professors of natural history, should give the best of their time every day to Museum work, especially in view of the fact that the majority of them were not paid at all. All had come with expectations of situations and reputation in the near future; and besides this, almost all possessed that independence of character peculiar to Americans, and more particularly to New Englanders. Agassiz was at first too lenient, and afterward became too exacting, while the liberty and equality existing there were not conducive to good discipline. In fact, all the regularly appointed assistants or student-assistants were working for themselves as much as they could. The curator had too much in hand to see that every one was doing his duty. Besides, no definite duties were assigned to most of the assistants; and if one was given the superintendence of a department, he had no one to help him, even in moving and carrying specimens, writing labels, or cataloguing and numbering the collections.

On the other hand, the assistants and pupils should have considered that it was a great privilege, and at that time an opportunity unique in all North America, to help in building up a great museum under the leadership of a naturalist of genius, and that they were there, not only for their own instruction, but also for the good of future generations. Egotism played too large a part with them, and caused Agassiz great disappointment. He had become very irritable through

overwork, and signs of failing health were only too visible. His young assistants ought to have been more considerate, and endured with more composure the weak points of their position. Both sides suffered by the separation, but the assistants suffered the most; and to this day the result of this secession is still visible on most of them, although they are all very proud of being old pupils of Agassiz.

CHAPTER XVIII.

1858–1864 (*continued*).

Darwin's "Origin of Species" — Cuvier, Agassiz, Owen, Lamarck, and Darwin — The Opponents of Agassiz in America — Asa Gray and Chauncey Wright — Parallel between Chauncey Wright and Karl Schimper — Two Classes of Naturalists — Revolution and Evolution — Pietist and Atheist — Lyell's Dissent — Neo-Lamarckians and Neo-Darwinians — Uniformitarianism — Spontaneous Generation — True Position of Cuvier and Agassiz.

Darwin's "Origin of Species" appeared in London, the first of October, 1859, a few days after Agassiz's return from Europe. The book was a disappointment to almost all naturalists. It had been heralded several years before it was issued as an event which was likely to revolutionize natural science, and so it did. Our friend Sir Charles Lyell more especially was enthusiastic and mysterious about it; but six months after its publication, when I visited him in London, I found him rather more frightened than pleased. He says, "Darwin goes too far. I am not prepared to follow him on natural selection and the geological succession of organic beings; the last more especially is still too incomplete to draw such sweeping conclusions."

In England adherence to, and even sympathy with,

Darwin's essay was rather limited. Besides Lyell and Wallace (then at Ternate, Molucca Isles), who accepted the new doctrine with reservations, there were only the botanist, Sir Joseph D. Hooker, the anatomist and essayist, Thomas H. Huxley, and two entomologists, H. W. Bates and Sir John Lubbock, who could be called, from the first, friends of the theory of the descent and modification of species according to Darwin's views. All the English palæontologists, with Sir Richard Owen at their head, were opposed to it; and not long after the appearance of the "small green-covered book," as it is called by Huxley, Owen in his library, at the Sheen Lodge, Richmond Park, used to make fun of Darwin's modification of species under domestication; and pointing to his pet dog, as he tried to catch flies, he would say, "My dog is in the act of becoming one of the insectivora."[1]

Darwin's old teacher at the Cambridge University, Professor Adam Sedgwick, was anything but pleased on receiving a presentation copy of the "Origin of Species," which he read "with more pain than pleas-

[1] Attempts have been made, not only to question the influence exerted on Richard Owen by Cuvier, but to place Owen among the Darwinists, and even to call him a precursor of Darwin in the much-controverted question of "Natural Selection." Owen, like Agassiz, was truly a disciple of Cuvier. Owen until the end of his life always uttered the name of Cuvier "with grateful reverence"; and in 1883 he wrote to Georges Frédéric Cuvier, nephew of Georges and son of Frédéric: "There are fashions of thought as well as of dress. A somewhat prevailing one, to which you allude, I have occasionally referred to as the *Biologie conjecturale*; but the science of living things which will endure is based on the foundation of the *faits positifs* made known, with the true methods of their discovery, in the immortal works of Georges Cuvier" ("The Life of Richard Owen" by Rev. R. Owen, Vol. II., p. 249; 1894).

ure. Parts of it I admired greatly, parts I laughed at till my sides were almost sore; other parts I read with absolute sorrow, because I think them utterly false and grievously mischievous. Many of your wide conclusions are based upon assumptions which can neither be proved nor disproved. . . . Darwin has deserted utterly the inductive track and taken the broadway of hypothesis" ("Life and Letters of Adam Sedgwick," Vol. II., pp. 356–357; Cambridge, 1890). Other celebrated English naturalists, like A. Murray, J. E. Gray, Harvey, and Henslow, would have none of it.

On the continent of Europe, the only open sympathizers were two botanists, Alphonse de Candolle of Geneva and Charles V. Naudin[1] of Paris; and as a matter of course, the learned and always most progressive geologist, J. J. d'Omalius d'Halloy, the steadfast friend and pupil of Lamarck, but he was rather sur-

[1] Previous to Darwin's publication, the French botanist, Naudin, had made some remarkable researches on the hybridization of plants; but all his efforts to penetrate the mechanism of variation of species had been unsuccessful. Another French botanist, Joseph Decaisne, desirous to prove for himself the question of variations, made a series of experiments, lasting more than twenty years, on the genus *Pirus*. He chose a rare example of cultivation of the pear tree, at the Garden of the Chartreux, Palace of Luxembourg, Paris, which had continued without interruption during several centuries. The number of typical species or varieties of pear trees cultivated there had reached, in 1871, the large number of fourteen hundred. As a result of his experiment, Decaisne arrived at the unexpected conclusion that all pear trees belong to an *unique type*, although a polymorph one; and writing to a friend in 1868, he said, "Si la nature n'a pas employé d'autre procédé [referring to the natural selection of Darwin] pour façonner le monde actuel, il ne doit pas être difficile de la prendre sur le fait," to which he added, "Je voudrois voir cela de mes yeux." Here lies the real difficulty, — the impossibility of seeing with one's own eyes the arrival of a new species.

prised to find that Darwin had almost entirely ignored Lamarck, as if he had never existed. For d'Omalius the "Origin of Species" was the "Philosophie Zoologique" of Lamarck in a new dress.

In America it was different. Under the leadership of the botanist, Asa Gray, and the geologist, William B. Rogers, almost all the naturalists became at once strong Darwinians. Agassiz tried in vain to stop the sweeping wave, but he was overwhelmed by the flood of publications and reviews. What was rather annoying to him was that the most enthusiastic propagators and apostles of the new gospel were not naturalists at all, with the exception of the systematic botanist, Asa Gray. Not one of them was a zoologist, in any sense of the word. Agassiz was too much a naturalist to accept a number of mere suggestions until they were scientifically proved by exact observations. In his eyes Darwin was an advocate of a foregone conclusion, who argued, not for the purpose of finding in what direction the evidence of any particular fact would lead, but for the purpose of finding something in the fact favourable to his preconceived opinion. Agassiz himself had had the honour to overthrow too many errors and false generalizations, not to be open to all new facts and investigations. But where were the facts? Darwin admitted the difficulties in his theory, which he tries to explain away, not by well-grounded facts and careful observations, but by various suppositions and many *ifs;* and these through frequent repetition seem to become established truths in his mind, and are used as arguments. On the contrary, Agassiz had gathered together, dur-

ing his many years of close investigations, a mass of facts which were not favourable to Darwin's somewhat hasty conclusions, and more especially to those of his followers, who at once exaggerated many of his views and conclusions.

This controversy brought to Agassiz's mind the great discussion between Cuvier and Geoffroy Saint-Hilaire, at the meetings of the Academy of Sciences of Paris, in 1830.[1] Cuvier, who was the greatest debater natural history has ever had, with his prodigious memory, had every fact at his tongue's end, and was always able to accumulate such a mass of proofs against an adversary that it was useless to oppose him. Although in this case Geoffroy Saint-Hilaire was right, as it has been amply proved since, he was fairly defeated in each day's encounter with Cuvier, and withdrew, so overpowered by his great opponent that he tottered like a drunken man, not knowing where he was, nor where he was going, so one of the witnesses of those discussions has told me.

Agassiz, although a rare teacher and a remarkable

[1] It began on the 22d of February, 1830, and was occasioned by a report made by Geoffroy on a paper, on the Organization of the Cephalopods, written by two young and obscure naturalists. In his report, Geoffroy advanced his new views on the unity of organic composition and unity of types — the result of more than thirty years of constant research. The discussions, which lasted, with one interruption only, during the whole year, are well summarized in the book published in May, 1830, by Geoffroy, under the title "Principes de Philosophie Zoologique," which may be considered as a basis for the classification of all the facts of comparative anatomy; and also in the chapter, "Discussion Académique de 1830," in the "Vie, travaux, et doctrine scientifique d'Étienne Geoffroy Saint-Hilaire," par son fils Isidore, pp. 366–385. Paris, 1847.

lecturer, was a poor debater. While Cuvier always kept cool and carefully selected every word he used, Agassiz, on the contrary, quickly lost patience, became excited, and showed signs of vexation. It should be said, however, that this was not the case with Agassiz until after he was fifty years old. I remember to have seen him very cool and under perfect self-control in several of the discussions on the glacial theory before von Buch, Élie de Beaumont, and other adversaries of his glacier theory, who on their part to a greater or less degree lost their tempers. At the meetings of the American Academy of Sciences and of the Natural History Society of Boston in 1860, objections against the acceptation of Darwin's theory led to several debates between him and Asa Gray and William B. Rogers, in which he was defeated, although he was right in all the facts he advanced to sustain his views and opinions. Some of his antagonists were excellent debaters and skilled in interrupting; and they annoyed him constantly by shaking their heads, or even saying a few words aloud, which disconcerted him and produced a painful impression. His opponents have reproached him for taking all that they said as directed against him personally when they were only making objections to his arguments and the views he expressed and defended. Probably the reproach is just, to a certain extent; but that Agassiz should take it as a personal opposition is easy to understand, and was at least partly authorized by certain facts. His great success and popularity in America had arrayed against him almost all the American naturalists, with very few exceptions. Even his position at

Harvard University was considered by some as unjustly bestowed on him, a criticism which was particularly applicable in regard to his geological work; and it was current among a certain public, happily a rather limited number, that the merits of Agassiz had been "much overrated in America." It would have been politic on his part if he had offered the chair of geology to William B. Rogers, then a resident of Boston. But Agassiz did not like to have any one so near, who might overshadow him.

But, however it happened, Darwin's "Origin of Species" became a thorn in his side. His pupils in a body turned against him, for they were delighted to believe that they knew more than he of the philosophy of natural history, the descent of man, the creative power of horticulturists, and of pigeon breeders, and the mutability of species and genera. To the disgust of Agassiz, they turned from their master to applaud all the articles on evolution and origin of species, published in American periodicals by Asa Gray,[1] Chauncey Wright, and John Fiske, the last two not even naturalists.

[1] Almost a year before the publication of Darwin's "Origin of Species," Gray, in January, 1859, read before the American Academy of Arts and Science, a paper in which, as he said in a letter to Torrey, he "knocked out the underpinning from Agassiz's theories about species and their origin, showing by the very facts that threw de Candolle, the high probability of single and local creation of species, turning some of Agassiz's own guns against him" ("Life of Asa Gray," Vol. II., p. 450). It is plain that Darwin's book came just in time for Gray, who seized upon it at once, and used Darwin's weapons against Agassiz with a quickness, which was not free from some passionate opposition. To be sure, Lamarck's "Philosophie Zoologique" was within Gray's reach, but it is

A few words on Chauncey Wright, and his singular similarity to another adversary of Agassiz, Karl Schimper, will not be out of place. Chauncey Wright was a mathematician of talent, who turned his mathematical skill to a study of the phyllotaxis of plants, just as Schimper had done forty years before. Agassiz treated Wright in the most friendly way, even appointing him a lecturer at his school for girls, just as he had treated Karl Schimper. Wright was an earnest seeker for truth, but he was above all a great dreamer, and some of his writings are rather obscure. He was suffering from the same weakness which afflicted Schimper, and presents a rare parallel to him. As his biographer and friend, Mr. Charles Eliot Norton, says, "He was never a persistent and systematic student, but he was essentially a persistent and systematic thinker" ("Philosophical Discussions," p. xvi., 1877; New York).

Asa Gray "had no proper training in biological science," Huxley says, and this was certainly true of Chauncey Wright, and especially of John Fiske. All three were ignorant of zoölogy, and it was almost comical to have Wright say, "Darwin's 'Origin of Species' renders Agassiz's essay on classification a useless and mistaken speculation; creation is a word pretending knowledge and feigning reverence."

In an address of Professor Asa Gray[1] on Professor Jeffries Wyman, we read, "I may venture to take the

doubtful if he had ever read it, not being very proficient in the French language. At all events, Gray's attention was not called to Lamarck's work until after the publication of Darwin's "Origin of Species."

[1] "Proceedings Boston Soc. Nat. History," Vol. XVII., p. 123. 1874.

liberty to repeat the substance of a conversation which I had with him [Jeffries Wyman] some time after the death of the lamented Agassiz, and not long before his own. I repeat the substance only, not the words."

"Agassiz repeated to me," he said, "a remark made to him by Humboldt, to the effect that Cuvier made a great mistake, and missed a great opportunity, when he took the sides he did in the famous controversy with Geoffroy Saint-Hilaire. He should have accepted the doctrine of morphology, and brought his vast knowledge of comparative anatomy and his unequalled powers to their illustration. Had he done so, instead of gaining by his superior knowledge some temporary and doubtful victories in a lost cause, his pre-eminence for all our time would have been assured and complete. I thought," continued Wyman, "that there was a parallel case before me — that if Agassiz had brought his vast stores of knowledge in zoölogy, embryology, and palæontology, his genius for morphology, and all his quickness of apprehension and fertility in illustrations, to the elucidation and support of the doctrine of the progressive development of species, science in our day would have gained much, some grave misunderstandings been earlier rectified, and the permanent fame of Agassiz been placed on a broader and higher basis even than it is now."

These opinions of Wyman, quoted and indorsed by Gray, indicate an inclination in both to say, "what a pity that Cuvier and Agassiz did not at once accept Lamarck's, Geoffroy Saint-Hilaire's, and Darwin's theories of descent; if they had done so, they would have been

greater men." On the contrary, both would have injured their record as exact observers and true savants. Their convictions were based on researches in laboratories, which had lasted all their long lives, and it would not have been to their honour to give up all the facts they had patiently accumulated, in order to adopt views contrary to what they had seen and observed. Both Cuvier and Agassiz were very honest, and had too high an idea of their priesthood in natural history, not to protest against the acceptation of theories not fully sustained by facts patiently accumulated. Darwin, in a letter to Sedgwick, says, that his volume on the "Origin of Species" was the result of more than twenty years' study, during which he "worked like a slave on the subject." But Cuvier also worked like a slave during forty years, and so did Agassiz.

Naturalists may be divided into two categories: those who are philosophical naturalists, and those who are, above all, guided by well-observed facts. Philosophers are all dreamers and isolate themselves as much as they can, not only from society, but even from companionship with their fellow-workers. Lamarck, although suffering from weakness of the eyes, and finally becoming blind, led an isolated life; he was not sociable even with his colleagues in Paris; and Pyramus de Candolle, who became his collaborator in the third and fourth edition of his "Flore Française," did not affiliate with him at all, while, on the contrary, he was intimate with, and a great admirer of Cuvier. Geoffroy Saint-Hilaire also became blind. Naudin was completely deaf. Darwin's constant suffering and complete isolation at

his country house, "Down, Bromley, Kent," are well known. We read in his life, Vol. I., p. 243: "Those two conditions — permanent ill health and a passionate love of scientific work for its own sake — determined thus early in his career the character of his whole future life." An avowal of Huxley to the son of Darwin may also be added: "Like the rest of us [which means Joseph Hooker, Asa Gray, Charles Lyell, and himself], he [Charles Darwin] had no proper training in biological science." Bates passed eleven years in the Amazon valley, cut off from all scientific society and absolutely isolated; and when I saw him in London, in 1870, he was living like a hermit. Wallace is another example of a traveller who lived year after year in the naturalists' paradise of both the new and old worlds: four years on the Amazons and eight years in the Indio-Malayan archipelago. During their long isolation, naturalist-philosophers are apt to theorize; more especially if, like Bates and Wallace, they start with the avowed purpose of finding the origin of species. The weak points seem to them only imperfections in the records, which will be filled up by and by, and each believes that he has found the laws of variation and of evolution in the organic world.

The second class of naturalists, who may be called classifiers and pioneer-naturalists, do not isolate themselves, and are anything but hermits. They work in laboratories as well as in the field, always well equipped and drilled to observe every organism; and they are disinclined to theorize, until all the facts lead them toward an inevitable conclusion. They are constant

attendants at scientific meetings of academies and natural history societies, discussing there every new fact brought up by any observer, whatever may be his scientific position and record. They try to classify the immense stores of collections around them, critically examining every specimen, and observing without prejudice everything that comes under their keen eyes.

The majority of them never indulge in dreams; or, if they do, they do not allow their imagination to go beyond the limit of speculation which can be easily seen and readily controlled by the immediate researches of their fellow-workers, as well as their own. To this category belong Cuvier, Agassiz, Owen, d'Orbigny, Deshayes, Ed. Forbes, Thomas Davidson, Pictet de la Rive, Herman von Mayer, Barrande, Lartet, Cotteau, and almost all palæontologists. Cuvier was unique for his constant adherence to facts. He never dreamed in his life. Agassiz, next to him, was influenced only by facts, though he dreamed now and then; but his great practical experience in both hemispheres soon put an end to all wild conclusions or hasty speculations which may have come now and then to his impetuous spirit, and brought him back face to face with the simple facts. Which of the two classes of men do the best work in natural history? is a question easy to answer. All true and solid progress is due to the second class and without them natural history could hardly be comprehended. Philosophical naturalists would find their task a very barren one if there were no classifiers, no embryologists, no palæontologists. It is very well to

theorize and discuss teleology, agnosticism, spiritism, morphology, mimicry, natural selection, evolution, transformism, etc., but before everything else we must know the history of every animal, of every plant, and accumulate all that constitutes the treasuries of every branch of natural history. Notwithstanding the saying of Bates that "Darwin and Hooker have elevated natural history into the rank of an *inductive science*, instead of being only *the observation and cataloguing of facts*" (letter to Dr. J. S. Hooker, March, 1861), it is difficult to decide how Bates would classify the comparative anatomy of Cuvier, the stratigraphical system of organized fossils of William Smith, or the Ice period of Agassiz.

There are two words which have an almost supernatural influence on the naturalists of the nineteenth century, — a circumstance which is easily explained when we consider how far humanity is led by words, and that fashion exists in everything human. During the first part of this century, the word "revolution" was extensively used in natural history. It was natural for persons who had witnessed the great French Revolution of 1789 to liken all that was extraordinary and difficult to explain in natural history to great revolutions. So Cuvier, with his "Revolutions de la surface du globe," started a whole literature. Everything was revolution and catastrophe. Humboldt spoke of revolutions in both hemispheres; Élie de Beaumont spoke of revolutions and elevations of mountain systems; de Boucheporn revolutionized the theory of the earth by his explanation that the changes in its axis were due to

the shock of comets, etc., etc. Later, since October, 1860, when Herbert Spencer, in his "First Principles of a New System of Philosophy," gave the following definition: "Evolution is the integration of matter and concomitant dissipation of motion," everything in natural history, and in social, political, economical, historical, and philological sciences, is evolution. It is not that the word "evolution" was not used before in natural history, although, curiously enough, Darwin did not use it once in his "Origin of Species"; for since the second half of the eighteenth century we find it used by Bonnet, and afterward by Laurillard, the assistant and right hand of George Cuvier, who recalled the observations of Bonnet on evolution. If Lamarck had used it in his "Philosophie Zoologique," his theory might have had another destiny during his lifetime. Darwin had the acuteness to see what a capital handle it would make for his theory, and as soon as he saw it in Spencer's work, he transferred the word into all his other works, speaking constantly of the "principles of evolution." His sympathizers took to evolution, and now evolution is everywhere. It has dethroned revolution completely. The word "evolution" *a fait fortune* according to a French proverb.

It is the only tie — certainly a very slender and elastic one — between all those who call themselves Darwinians;[1] although the word does not occur at all in the "Origin of Species." In this connection a few quotations from "Asa Gray's Life and Letters" are

[1] There is only one exception, Alphonse de Candolle, who used the word "transformism" as preferable to "evolution," because, as he says,

interesting. He says, "Lyell considers the case [transmutation question] as not yet ripe for a decision." "Lyell does not come out as an advocate of natural selection, transmutation" (both Darwin and Hooker complain of it). "Lyell has presented the case of transmutation so as to commend it as much as possible to us orthodox people. [Huxley would have put it in a way to frighten us (orthodox) off.]" Here is the great obstacle between Gray and Huxley, and even Darwin. Gray says, "As to the Exeter meeting of the British Association, I am, on the whole, glad enough to keep away, especially from Darwinian discussions, in which I desire not to be at all *mixed up* with the prevailing and peculiarly English materialistic, positivistic line of thought, with which I have no sympathy, while in natural history I am a sort of Darwinian" ("Letters of Asa Gray," Vol. II., p. 592). And in two other places Gray says: "In Darwin's contributions to teleology, there is a vein of *petite malice*, from my knowing well that he rejects the idea of design." "You (Darwin) see what uphill work I have in making a theist of you of *good and reputable standing*." Darwin is in favour of chances, while Gray feels a "cold chill" when Darwin brings him to the point of co-adaptations in orchids. Certainly the association of an orthodox Presbyterian, or strict Puritan of the old school, like Gray, with the agnostic and materialistic Darwin and Huxley is curious. Circumstances made Gray a Darwinian, for

the successive changes of forms do not occur always in the direction of a greater development, being sometimes in the direction of simplification or even of the production of monstrosities ("Darwin," 2d edition, p. 35; Genève, 1882).

he always stopped short of complete deduction. For instance, when he says, "in Bates's geographical varieties, etc., we get about as near to seeing a species made as we are ever likely to get." Darwin and Huxley do not think so. Gray leaned towards Owen's definition, that species are somewhat derived genealogically, and he urges Darwin "not to insist much on natural selection, if you can only have derivation of species"; and adds, "derivation of species is to be the word." Finally, Gray accepts the conclusions of Darwin as a "probable hypothesis."

As to Lyell, he says in a letter to Darwin, "I cannot go Huxley's length in thinking that natural selection and variation account for so much, and not so far as you, if I take some passages of your book separately. I think the old 'creation' is almost as much required as ever, but, of course, it takes a new form if Lamarck's views improved by yours are adopted" ("Life of Charles Lyell," Vol. II., p. 363).

In another letter also to Darwin, he says, "Lamarck's belief in the slow changes in the organic and inorganic world in the year 1800 was surely above the standard of his time, and he was right about progression in the main, though you have vastly advanced that doctrine" ("Charles Lyell," Vol. II., pp. 365, 366). And farther on Lyell entirely breaks with some of the main conclusions of Darwin, as when he says, "I feel that progressive development or evolution cannot be entirely explained by natural selection. I rather hail Wallace's suggestion that there may be a Supreme Will and Power which may not abdicate its functions of interference, but may guide the forces and law of Nature. . . .

At the same time, I told Wallace that I thought his arguments as to the hand, the voice, the beauty and the symmetry, the naked skin, and other attributes of man, implying a preparation for his subsequent development, might easily be controverted" ("Charles Lyell," Vol. II., p. 442).

Lyell is the only Darwinian who has made any reference to "spontaneous generation." It is in a letter to Charles Darwin, dated March 15, 1863 ("Charles Lyell," Vol. II., p. 346). Curiously enough, he calls Richard Owen "a disciple of Pouchet" of Rouen. Darwin and Huxley have gone as far as it was possible for them to go, in reducing the initiative beings on earth to four or five cells, even to a single one, according to Darwin's most intimate thought. From that cell to spontaneous generation there was an easy passage, especially for materialists and agnostics. But the very exact and splendid experiments of Louis Pasteur, proving beyond discussion that "spontaneous generation" does not exist, broke the first link of their chain of reasoning for the "Origin of Species," and they all by common consent passed over it as too dangerous ground.

Gray's slight knowledge of geology, palæontology, and zoölogy led him to overestimate the value of both Lyell and Darwin, when he says, "It is interesting to see how early he [Lyell] took to the line which he followed in his whole life's work, and which has changed the face of geology and philosophical natural history. For, indeed, Lyell is as much the father of the new mode of thought which now prevails as Darwin" (Letter of Gray to A. de Candolle in "Letters of Asa Gray,"

Vol. II., p. 732). The influence of Lyell on geology, outside of a very limited circle in the British Isles, is absolutely insignificant. Geology has been built up entirely outside of his "line of work," by practical geologists and original observers, as well as by great thinkers. That Lyell was a charming character is true, and it is also true that he influenced Darwin, but he did not in the least change the face of geology.

The publication of some letters of Darwin, Lyell, and Gray, in their respective biographies, although carefully selected, apparently to do honour to their authors, shows in part the inside history of the strong divergences existing among evolutionists and uniformitarians. Both Lyell and Gray feel "cold chills" every time they come to the full conclusions drawn by Darwin, Huxley, and Wallace. They had to come face to face with agnostic and antitheistic ideas. The bridge they had to cross seemed to both of them too insecure to trust their feet on it, just as Agassiz and many others refused to cross the bridge of the "Origin of Species" of Darwin.

Some of the quotations from the letters of Darwin are certainly amusing. He calls Hooker "a barrister, a great lawyer"; Lyell is "a Lord Chancellor"; Asa Gray is "a born reviewer, a capital reasoner, a poet, a hybrid, a complex cross of lawyer, poet, naturalist, and theologist! was there ever such a monster seen before?" And he wrote to Asa Gray, "You have made a mistake in being a botanist; you ought to have been a lawyer" ("Darwin's Life," Vol. II., p. 120). This is true. Lyell, Hooker, and Gray were certainly lawyers,

and all three constantly applied lawyers' methods to natural history. No one of them possessed the naturalist spirit and turn of mind.

Of Joseph Prestwich, Darwin says, "I fear he is too much of a catastrophist." For him "Huxley is a regular reviewer." Never a man was more inclined to paradoxes than was Darwin. For instance, he says, "A compiler is a great man, and an original man, a commonplace man"; "only fools can generalize and speculate" (in a letter to Hooker). His treatment of Lamarck's views and observations do not speak in his favour, for in one place he says that Lamarck's work appears to him "extremely poor"; and again, "I got not a fact or idea from it." Lamarck's book is "absurd, an absolutely useless book," and all that Lamarck did is "rubbish." However, he admits that Lamarck is the only exception among all those who have described species, for he did not believe in the immutability and permanence of species.

Darwin applied the word "rubbish" rather at random, and not always to the point. For instance, he characterized by that title the great discovery of the antiquity of man by Boucher de Perthes at Amiens, and a few months later he scolds Lyell for not rendering sufficient justice to Boucher de Perthes in his book "The Antiquity of Man," saying that "Boucher de Perthes has done for man something like what Agassiz did for glaciers."

On the whole, Darwin was a great sceptic, and a lover of paradoxes, full of preconceived ideas, although he constantly protested that he had never had any, ex-

cept one, and that one was very unfortunate, for it was in regard to the formation of atolls by corals, which he preconceived when on the coast of South America, before he had seen a single coral island of Australia. Since 1874 Darwin's theory has been so often damaged by the numerous facts brought forward by Semper, John Murray, Agassiz, Guppy, and Bourne, that it is now regarded as an exploded hypothesis.

As a matter of course, like all zoölogists, with the unique exception of Edward Forbes, Darwin was opposed to the theory of change of place of the continents and oceans. Although an evolutionist of the most radical type when applied to animals and plants, he was ultra-conservative and even retrograde in his views of the permanence[1] of seas and lands.

To this day there has been nothing but chaos in regard to the questions agitated by the new school. All disagree on some of the most important points; and if Darwin, according to Gray's expression, "has turned the world of science upside down," he has failed to give a doctrine well based and acceptable as an indisputable truth, like the glacial theory, the strata identified by organized fossils, the primordial fauna, comparative anatomy, and historic and chronologic geology.

As Agassiz says: "Suppose that descent of species is proved as correct; in what are we more advanced

[1] This is a rare contradiction of all the views and opinions advanced by Darwin, and almost incredible from a geologist who had made a journey round the world. Immutability of oceans and lands is a greater heresy in the eyes of all true practical geologists than immutability of species for Darwinians.

in our knowledge of them? Can we dispense with a study of the organism, the embryology, the exact position each species occupies in classification?" True progress in natural history does not depend on fine theories, hypotheses, and philosophy. What is wanted are new observations, new facts, new deductions well based on facts absolutely undeniable.

We shall always have a quantity of theories. We already hear of neo-Darwinism, of neo-Lamarckism; one need not be much of a prophet to predict that we shall see several other "neos" during the next century.

Cuvier and Agassiz did not believe in the descent of species and in transformism; they knew well that species vary, that intermediate forms exist, that links are constantly found; but all this did not shake their faith in the existence of species and genera. They were unwilling to go beyond what they saw with their own eyes and what they touched with their own hands.

Slow action *à la* Lyell and Darwin is very well, but principles of uniformitarianism are constantly disturbed by facts which confront every honest and careful observer, and which cannot be explained in any satisfactory way, except by the presence of paroxysms, catastrophes, and revolutions among the forces of nature as we have them now under our eyes. Before such facts, evolutionists and uniformists are at a loss, totally disagreeing among themselves. For instance, the glacial epoch has been a thorn in the flesh of Darwin, Wallace, Bates, and others, each one disagreeing with the others.

Between variations of extinct species and their affinities to each other and to living species, and transformism, or the theory of descent from common parents, there is a gap; rather, an immense abyss, over which Agassiz was not willing to leap. A bridge was needed, but natural selection seemed to him too frail a structure for so dangerous a passage. In his view, natural selection[1] was only a beautiful circumlocution; for he clearly saw that selection in natural history could not be other than natural. When naturalists like Cuvier, Agassiz, Barrande, Owen, Pictet, Lartet, Deshayes, etc., hesitate, it is simply because the conclusions presented to them are too full of obscurity and of supposition. True savants, accustomed to rigid scientific methods and exact principles, do not like to move in the dark. It is possible that for some of them,

[1] Darwin had obtained his idea of natural selection from the work of Malthus, as he says in his introduction to the "Origin of Species," and also in a private letter, published by Haeckel. The idea was not original with him, but only an application to all the animal and vegetable species of what Malthus held to be the principle governing the human species in its struggle for existence. Curiously enough, Wallace also got the same idea of natural selection from reading Malthus, while in camp in the jungles of Java, and he at once outlined the "revelation," which had come to him almost as an "inspiration." After all, it was simply a coincidence in the minds of two men who were interested in the same subject and were trying to theorize in regard to the progress of life through some sort of agency. Malthus furnished "natural selection," and at once both Darwin and Wallace found that their ideas had fashioned themselves into a complete system. So Malthus is the revelator and inspirer of what has been called by an enthusiastic admirer of both Darwin and Wallace "the greatest synthetical emanation of the scientific mind of our day." To this case the saying of Marshal Canrobert after the cavalry charge at Balaklava, "C'est beau, mais ce n'est pas la guerre," may be applied, with a slight change: "C'est beau, mais ce n'est pas l'origine des espèces."

like Huxley, the way may seem clear. However, even Darwin declares that it is not easy, and that he was constantly troubled by hesitation, and even doubts. Agassiz was perhaps too cautious, but no true naturalist will blame him, and the position he took in the controversy has been fully justified.

All branches of natural history, except mineralogy, are now in a transitory state, and our ignorance on many most important points is very great. In fifty years, our successors will be in a better position to form a judgment. The records of a Cuvier and of an Agassiz, with their admirable works on classification, comparative anatomy, palæontology, embryology, glacial doctrine, can await the test of time.

By way of résumé, we may say that at present the theory of descent as set forth by Lamarck and Darwin has not been established by incontestable facts and observations. Agassiz was unwilling to abandon the method of exposition of facts which he had found established in science, and to substitute in its place metaphysics and hypotheses; he clung to observation and experiment. Man has not yet found the secret of creating species; it is true, man has the power of destroying species, as he has already shown by the extermination of several species of animals. But the question of mutability of species and the method of effecting it are still reserved for future observers; and not until we possess unquestionable proof of their soundness will transformism and descent be accepted in science. Notwithstanding all that has been advanced as to predestined *evolution*, by Naudin, Minart, Koeliker, and

others, the bold assertions of Haeckel,[1] the natural selection of Darwin and Wallace, are hypotheses insufficient to prove the reality of the origin and descent of species.

De Candolle insists that transformism is no longer an hypothesis, but a proved fact, and that the only hypothesis lies in the explanation of the process of variation of species and their propagation. Herein is the whole difficulty. Agassiz has proved that each individual, in his embryologic development, passes through forms analogous to those of species which have existed in geological times. If the Darwinists can replace their hypothesis of process of variations

[1] Haeckel's attacks upon Agassiz's character, calling him an "hypocrite and a charlatan," are happily unusual in natural history. At all events, they do not prevent him from making use of Agassiz's discoveries, as it is proved by Alpheus Hyatt, who says: "Therefore, while the law of correlation of the stages of development and those of the evolution of the phylum may, if one chooses, be called a law of biogenesis, it is more accurate to consider it a law of correlation in bioplantology; or, better still, the law of palingenesis, or regular repetition of ancestral characters, which very nearly expresses what the discoverer, Louis Agassiz, saw and described. The fact that Agassiz was wrong in his theory, not believing in evolution and not recognizing the meaning of his laws in this sense, does not absolve those who profit by his labours from recognizing his discovery of the facts, and his obviously full acquaintance with the law and its applications to the explanation of the relations of organisms. It is Agassiz's law, not Haeckel's" ("Philogeny of an Acquired Characteristic," by Alpheus Hyatt; "Proceed. Amer. Philosophical Society," Vol. XXXII., p. 390; Philadelphia, 1894).

Ernst Haeckel is trying to play — in the origin of species — the rôle of a Mahomet, and like him is very intolerant against all those who do not accept his "creed" and use his method of doubt on the problem of life, as his last work, "Monism. The Confession of Faith of a Man of Science," London, 1894, sufficiently proves. His preconceptions on matters which fall within the provinces of research and discovery are anything but scientific.

of forms, by proofs based on observations easily repeated and accessible to every one who studies species, then we shall understand the origin of species by accidental transformation, which they want us to believe. The theory of the followers of Cuvier does not differ so much from that of the transformists as is generally supposed. The plan of both is the same; in both, intermediate species have always been recognized, and the discovery of links between past forms and new ones is mainly due to the researches of Cuvier, Agassiz, Owen, and others. But it is the part played by accident, as a sort of mechanical process constantly made use of by Darwin and his school, which fails to explain an enormous amount of palæontological and biological facts, which are all left to be accounted for by pure hypothesis. Suppress all hypotheses, *if possible*, and then the two schools of immutability and mutability of species will unite. But as long as hypotheses are the main factors in the problem, it will remain a problem, and not a final solution.

If natural selection or other expedients proposed by Darwin and his school will account for the origin of species, the mechanical process resorted to should not be difficult to get at. Laboratories for biological research exist now in great numbers, in both hemispheres, and if it is as simple as Darwin, Wallace, and Haeckel are inclined to think, we shall before long have new species to add to the catalogues of plants and animals. If, on the contrary, no new species is produced, we shall be obliged to have re-

course, in some way or other, to the "Supreme Will and Power," according to Lyell's phraseology, or to the creation or at least sudden appearance of organized being, which Cuvier and his school have maintained as the only rational hypothesis. "Nous verrons!"

CHAPTER XIX.

1858–1864 (*continued*).

"The Philosophers' Camp" in the Adirondacks — The Saturday Club — Death of Professor Cornelius C. Felton — Social Relations with Mr. George Ticknor and Mrs. Julia Ward Howe — Acclimatization of American Marine Animals on the Coast of France — Enlistment in the Army of Several of Agassiz's Pupils — A Grant of Ten Thousand Dollars by the Legislature of Massachusetts in 1863 — Lecturing Tour in the West during the Winter of 1863–1864 — Collections of Fossil Crinoids at Burlington, Iowa — Dr. George Engelmann of St. Louis — The Title of his Museum — Glacial Exploration in Maine.

During all these years social life was at its height with Agassiz. In August, 1858, the "Saturday Club" made a summer expedition to the Adirondacks, under the leadership of the poet — afterward diplomatist — James Russell Lowell, who was the youngest and the most energetic of the "philosophers' camp." A roughly built shelter, with a roof of fir bark, on the shore of Follansbee Pond, a small lake in the Raquette Mountains, not far from Keeseville on Lake Champlain, served as tent for the whole party, which was composed of Agassiz, Ralph Waldo Emerson, Lowell, John Holmes, Dr. E. Howe, Judge Hoar, A. Binney, Jeffries Wyman, and a few others. The life was rather rough; all were in flannel shirts, red or blue, and slept wrapped

up in blankets on fir boughs. Game and fish were abundant, and the fare good. Longfellow had declined point blank to go, because Ralph Waldo Emerson, whose mind was always wandering among the temples of Greece and Rome, and seldom concerned with reality, had taken a gun. When asked why he refused to join them, Longfellow's ready answer was, because "somebody will be shot." However, nothing was shot, except deer.

It was the custom at the "philosophers' camp" every morning after breakfast to practise firing at a mark, during which time Agassiz, Wyman, and an assistant would dissect and prepare their specimens. One day some one asked Agassiz to shoot at the mark; and on his hesitating to accept the offer of a rifle, the whole company joined in the request, urging that a man with such eyes must be a capital shot. Not one of them knew or imagined that Agassiz had never fired a shot in his life. Finally Agassiz took aim, fired, and put the ball in the eye of the mark, which gave occasion for much applause and many compliments. Further solicitations found him immovable, and he firmly declined to fire another shot. He had been too lucky to try again, and this was actually the only shot he ever fired.[1]

[1] In a letter to Cuvier, written about 1827, Agassiz mentions that he "practised arms, the bayonet and sabre exercise" (Mrs. Agassiz's "Life and Correspondence of Louis Agassiz," Vol. I., p. 108), which seems to indicate that he then used a gun. But it was not so. William Schimper, the brother of Karl, when he joined Agassiz at Munich, had just left the Baden military service as a non-commissioned officer; and he drilled Agassiz in the use of a gun, without firing it. Agassiz always declined to fire a shot, and would give no reason for his refusal.

In Boston and Cambridge dinner parties succeeded each other so rapidly that it was a wonder that any man could stand such a strain on his digestive powers. Agassiz was a member of all the fashionable clubs of the time, and besides was a welcome guest at the hospitable tables of all the leading families of Boston. A description of one of these meetings will suffice. Dr. Holmes, the great humourist and poet, says, "At the other end of the table [of the "Saturday Club"] sat Agassiz, robust, sanguine, animated, full of talk, boy-like in his laughter." They lingered long round the table, while hour after hour passed in animated conversation, in which *bon mots* and repartee were exchanged as rapidly as a discharge of fireworks — an encounter of anecdote, wit, and erudition. At such times Agassiz was at his best, with his inexhaustible *bonhomie*. With a lighted cigar in each hand, he would force the attention of every one around him. Excited by the pyrotechnic wit of James Russell Lowell, Judge Rockwell Hoar, and the author of the "Autocrat of the Breakfast Table," Agassiz, whose vivid imagination was always on the *qui-vive*, was not a man to let others eclipse him. Then would come one of his made-up stories — a mixture of dream and science. He knew perfectly well that it was a fiction, and the first time he told it he hesitated a little. If he thought any one in the company was doubting its truth, he would look at him with a dumb request not to betray him. On the next occasion he would repeat the same story without any hesitation; and the third time he told it, he was sure that it had really happened, and was true. Agassiz would have

been very truthful, if he had had less fire and brilliancy in his imagination, always too easily excited. In principle he was honest, because he believed all that he said. For him the Italian proverb, "si non e vero e ben trovato," was an article of the code of conversation in after-dinner talk among witty gentlemen. Very appreciative of a well-served table, of witty conversation, and of the company of ladies, his *gaulois* spirit formed a relish, as it were, for his more serious and guarded American friends. As Lowell says of him, "Blood runs quick in his veins, and he has the joy of animal vigour to a degree rare among men — a true male, in all its meaning."

Lowell was a special favourite with Agassiz, and knew him thoroughly. As Agassiz was always a great walker, he and Lowell, after a long sitting at the "Saturday Club," in the early hours of morning, would come back to Cambridge on foot, Agassiz continuing his confidential *gauloiseries*, begun "under the rose," until the joyful companions were forced to separate, a parting which Lowell has so well described in his memorial poem entitled "Agassiz": —

> "At last arrived at where our paths divide,
> 'Good night!' and, ere the distance grew too wide,
> 'Good night!' again; and now with cheated ear,
> I half hear his who mine shall never hear."

While returning from one of these Saturday Club meetings, Agassiz was greatly shocked by the sudden illness of his friend, President Felton, who suffered a severe attack of heart disease, as they were walking home. It proved a first warning of death; and some months later,

on the 26th of February, 1862, a second attack prematurely ended the life of one who had been a most devoted friend and true brother to Agassiz.

Ever since his arrival in Boston, in 1846, Agassiz had been not only a welcome guest, but a great favourite, at the house of Mrs. George Ticknor. Mrs. Ticknor's literary "salon" exerted, during the middle of the nineteenth century, a great influence on New England society. There gentlemen and ladies, distinguished for their literary attainments, their education, their high official position, met daily. Foreigners, as well as Americans, came and went constantly under this charmingly hospitable roof; and Agassiz, when in Cambridge, was one of the most assiduous "habitués." Although not scientific, both Mr. and Mrs. Ticknor enjoyed the conversation of savants. Sir Charles Lyell and Lady Lyell were guests at the Ticknors' during each of their visits to America; and Agassiz ran in almost every time he came to Boston, sure to find there, not only friends, but sympathizers and often helpers of his never-ending schemes for the progress of natural history in North America.

Another house where Agassiz was often a most welcome guest was that of the director of the Perkins Asylum for the Blind at South Boston. Dr. S. G. Howe, the philanthropist, and his gifted wife, Mrs. Julia Ward Howe, appreciated Agassiz at his real value as soon as they knew him. The friendship was reciprocated; and it was no small privilege and enjoyment to hear a conversation between him and Mrs. Howe, both geniuses, and spirited and witty to a rare degree.

Charles Sumner, although a good friend, was too much engrossed by politics for Agassiz, who never much relished political societies and meetings. Natural history discussions left no time for other debates. Outside of his natural history pursuit, pictures, especially landscapes, were the only things which attracted him, although he had little time to devote to them. He saw at once the quality of a picture; and I have seen him lost in admiration before Alpine landscapes by Calame, Diday, and Töpffer, or beautiful "paysages" of the Jura Mountains by Gustave Courbet.

At the beginning of the Civil War Agassiz received, through M. Jules Souchard, the French consul at Boston and his personal friend, a message written by order of the Emperor Napoleon, asking information in regard to the acclimatization of several marine animals living in the American Atlantic. With his usual promptness to help in anything relating to natural history, Agassiz took the trouble to send, in charge of his old friend Burkhardt, a whole cargo of living *Mya arenaria*, *Venus mercenaria*, *Pecten concentricus*, *Homarus americanus*, *Mactra solidissima*, and *Mytilus edulis*, which might be experimented with at the oyster station near Havre. The passage from Boston to Liverpool, which was made just at the equinoctial time, at the end of September, 1861, was very stormy and long; and almost all the animals died during the voyage, notwithstanding the care of the captain of the steamer, James (afterward Sir James) Anderson, a special friend and great admirer of Agassiz.

Agassiz, Burkhardt, and Anderson took every pre-

caution possible in this first experiment of sending living marine animals across the Atlantic; but owing to adverse circumstances, not only the long and protracted journey over the Atlantic, but also the journey from Liverpool to Havre, only two hundred live specimens of *Venus mercenaria* arrived at La Houge de Saint-Waast, on the island of Tatihou, in the marine aquarium, near Normandy's coast, Havre.

Burkhardt was presented to Napoleon at the Tuileries, who thanked him for the part he had taken in the difficult task of conveying such an unusual cargo; and Agassiz received through his friend Souchard the imperial thanks and the cross of officer of the Legion d'honneur. The failure did not discourage further experiments. On the contrary, the difficulties encountered by Burkhardt were taken into consideration; and other cargoes were sent across in 1862, with complete success, by a lieutenant of the French navy, M. Philippe de Broca, sent for that special purpose by the Secretary of the Navy. M. de Broca carefully followed all the instructions and advice given to him by Agassiz; and although two-thirds of the animals sent over at different times during his stay in the United States died on the voyage, a third of them, about ten thousand specimens, arrived alive and in tolerably good condition.

Agassiz much enjoyed the society of Jules Souchard, the French consul, and he and Agassiz arranged a weekly meeting half-way between their two houses. Every Sunday afternoon each set forth from his home at the same hour, and walked toward the other until they met. Then they continued the walk together as

far as the house of one or the other, alternating each week, whence, after enjoying a glass of French wine and cigars, the visitor would return by a horse car. This friendly arrangement lasted several years, until Souchard returned to France in 1867.

The Civil War was a terrible hindrance to the progress and prosperity of Agassiz's Museum. First of all, almost half of his assistants and pupils left to enlist in the army. Three of them died there, — N. Bowditch, C. A. Shurtleff, and A. P. Cragin. Nathaniel Bowditch, son of Dr. Henry Bowditch, was killed on one of the battle-fields of Virginia. Albert Ordway rose rapidly to be colonel, and finally brigadier-general, of United States volunteers. He had had charge of the crustacea at the Museum, and had begun good work on the trilobites, but he unfortunately never returned to the Museum, and has been lost to science. Alpheus Hyatt remained over a year in Louisiana on the staff of General Banks, the commanding officer, and after good service returned as captain of volunteers in 1863, several months after his time of service was over, for he was so appreciated by his chief that General Banks would not allow him to return earlier. Hyatt, more than any other assistant of the Museum, deserves credit for having enlisted for active service, because, educated in Maryland, his family were in sympathy with the South, and in enlisting in the Northern army, he encountered their strong opposition.

Albert Bickmore deserves more than a passing notice, for he made use of his spare time in the army as a nine-months soldier to make a splendid collection

of the marine animals, more specially shells, of the coast of North Carolina. Being only a private in an infantry regiment, he was detailed upon special hospital duty near the seashore. There almost daily he explored the beaches, going often so far as to trespass on the Confederate lines, wandering in his pursuit of shells, on rather dangerous ground for a boy in blue, for he always wore his military dress. The least that could have happened to him was to be made a prisoner of war, but somehow his pursuit was so earnest, he seemed so indifferent to danger, so absorbed in collecting shells, that the Confederates looked on him as a sort of inoffensive "crank," and let him alone. Bickmore is now the efficient curator of the American Museum of Natural History at the Central Park, New York City. He was a modest pupil, and does credit to Agassiz.

Theodore Lyman, appointed colonel on the staff of General Meade, served with distinction until the end of the war.

The other pupils and assistants did not enter the army. Mr. Alexander Agassiz was confined to the halls and laboratories of the Museum, where he did excellent and valuable service.

I was the only person attached to the Museum who crossed the belligerent lines. In the fall of 1863, I ventured on a geological exploration in Nebraska. At that time there was no railway in Iowa, and to go from Burlington, Iowa, to Omaha, I was obliged to pass through all the northern part of Missouri, the most rebellious part of that state. Railroad trains were constantly held up by guerillas and bushwhackers on the

Hannibal and St. Joseph line, notwithstanding the garrisons of United States troops stationed in and around block-houses at several important points of the road, and the day before I passed, the train had been fired at and stopped by a party of guerillas. However, I arrived safely, and embarked at St. Joseph to go up the Missouri River. My exploration was very successful, and I brought back to the Museum important collections of fossils. Agassiz congratulated me on my return, saying that he was not without some apprehension as to my safety.

Several other pupils of Agassiz, who came during 1862 and 1863, have since distinguished themselves in natural history. I would mention William H. Dall, the efficient curator of invertebrates at the United States National Museum; William H. Niles, professor of geology and geography at the Massachusetts Institute of Technology; Horace Mann, the explorer of the Sandwich Islands; and the entomologist, P. R. Uhler.

As I have said, the Civil War retarded the progress of the Museum, for it was no time to ask for money when all the resources of the country were required to carry on the war. Still, in 1863 Agassiz obtained from the Legislature of Massachusetts a grant of ten thousand dollars for the publication of an illustrated catalogue of the Museum — the best proof of his great popularity among the inhabitants of Massachusetts.

The want of money became so pressing in 1863, that Agassiz bravely made a last effort to obtain it, by a grand lecturing tour in the West. The Museum had existed for only three years then, and to surmount the

scarcity of funds, increased by the depreciation of government money, was of prime importance almost for the very existence of the new institution. With his ordinary pluck and courage Agassiz did not hesitate for a moment, and plunged into the scheme without a doubt of his success, and at the same time trusting to the herculean strength of his constitution to bear the strain. However, he presumed too much on his endurance, and those near him realized his danger. Although everything which love could imagine was done to help him and spare unnecessary fatigue, Agassiz returned from his tour, on which his admirable wife had been always at his side, much exhausted and broken down. At the age of fifty-six the strain was too great. Going from town to town, from Buffalo, Cleveland, Detroit, Chicago, to St. Louis, lecturing always before crowded audiences, from December, 1863, until March, 1864, was a veritable *tour de force*, which it would have been absolutely impossible for him to repeat. Happily, although money was always wanted in larger quantities than it came, Agassiz was not again embarrassed by lack of pecuniary aid. To be sure, he was always in pursuit of money, pressing the Massachusetts Legislature not to forget his museum, but aid came more readily from private individuals, and the periodical crisis concerning money, to which he had been subjected all his life, at last passed away, never to return.

When in Chicago he planned an excursion to Burlington, Iowa, on his way to St. Louis. In my visit to Burlington in September, 1863, I had been absolutely astounded by the extraordinary wealth of fossil crinoids

displayed in three private collections belonging to citizens of that town. After my return, I had spoken of them in such glowing terms to Agassiz, who knew how difficult it was for me to become enthusiastic over anything touching collections, that he resolved to see for himself. He found that the reality surpassed all his expectations, and at once he was eager to have all three of these collections transferred to his museum. The temptation proved too strong to resist, and he purchased one, promising as soon as his means would allow to purchase the others, which he did a few years later. Finally, the great and unique collection of Dr. Charles Wachsmuth, containing almost all the typical specimens described of Western fossil crinoids, was safely stored in the numerous drawers of the Agassiz Museum, under the direction of Dr. Wachsmuth himself. What a devourer of collections Agassiz was!

At St. Louis Agassiz enjoyed the society and companionship of Dr. George Engelmann, an old classmate at the Heidelberg University, and their reminiscences of student life and intimate association with Karl Schimper and Alexander Braun, revived their young days, when morphology of plants was the constant subject of their thought and talk. In fact, Engelmann's first paper, written as his thesis, or inaugural dissertation, for his degree of Doctor of Medicine, in 1831, was entitled "The Morphological Monstrosities of Plants." Engelmann's character and spirit were most congenial to Agassiz, who appreciated him highly, for, in the words of his life-long friend, Dr. A. Wislizenus, Engelmann "was firm and decided. He did

not rely upon speculations in his scientific researches, but on facts only, ascertained by severe and searching studies. He was strictly true in scientific matters." Both have followed constantly the same principles in their researches and classifications, and Agassiz much admired Engelmann's great works on the *Cactaceæ*, the *Yucca*, the *Agave*, *Juncus*, *Coniferæ*, the *American oaks*, etc., etc. After the passionate discussions on the "Origin of Species," it was a great comfort to Agassiz to find a botanist not given to speculations and theories, but standing firmly on plain and proved facts.

Agassiz passed the summer at Nahant, where he had a seaside laboratory close by the cottage of Mrs. Agassiz, a charming place of resort for a naturalist, much enjoyed by him and his children. Naturally Agassiz kept every one round him busy, directing the microscopical studies and researches, superintending the drawings, and giving his leisure time to dreams of schemes to increase the usefulness and wealth of his dear museum.

Now a word in regard to the name given to his creation, no longer in its infancy, but in full vigour. *Museum of Comparative Zoölogy* is a very long title, especially for common people; and for a man like Agassiz, who always courted popularity, it may seem strange that he made such a choice. First, the name is a pleonasm, for it is impossible to work at zoölogy without making comparison. It is not so with anatomy; and Cuvier, in creating *comparative anatomy*, used a proper term for a new science. Agassiz knew

this perfectly well, and one day, in a mood of confidence with me (after his forty-fifth year Agassiz, until that time extremely frank, saying even more than was prudent, became rather reserved and reticent), admitted the fact that the title was not very appropriate. "I did not want the name of any patron or benefactor given to it," he said; "Mr. Peabody, the generous American banker of London, has informed me that he will endow the Museum with a large sum of money, but on the condition that it shall bear his name; that I cannot accede to." "Of course," said I, looking him full in the eyes, "it will be *Agassiz's Museum.*" "Yes," he answered feebly, "you have ferreted my secret."

To repeat this now is not to betray my illustrious friend. Every one, savant or illiterate, native or foreigner, calls it "Agassiz's Museum," notwithstanding the great sign, "Museum of Comparative Zoölogy," sculptured in big letters over the gate. It is simple justice, and the reward conferred by universal consent on the man of genius who created it, from nothing, with his brain and invincible will. After all, men are not ungrateful, even in a republic.

His summer at Nahant not having given the relief that he expected, as a means to restore his health and get more strength for the next year's work at the University, he made, during the whole of September, 1864, an extended excursion into Maine, looking for glacial remains. He extended his researches for moraines and oesars — now called drumlins — from Bangor and Katahdin to Mount Desert, and carefully studied

what are called "horse-backs." His Alpine experiences of twenty and more years before came vividly before him, when in presence of the morainic material accumulated all over the state of Maine, and after returning home he dictated one of the best articles he contributed to the "Atlantic Monthly," under the title, "Glacial Phenomena in Maine."

CHAPTER XX.

1865–1867.

Journey to Brazil — His Companions on the Journey — Burkhardt's Illness and Death — Agassiz's Reception by the Emperor — Major Coutinho — Explorations on the Amazons River — Two Steamers placed at the Disposition of Agassiz — Traces of Glacial Phenomena in the Province of Ceará — Results of the Journey — The Copley Medal — Agassiz's Naturalization as an American Citizen — The National Academy of Science — Dr. Brown-Séquard — Another Series of Pupils and Assistants — Death of Mrs. Rose Agassiz, née Mayor.

Ever since 1828, when a student at Munich, he undertook the publication of the "Brazilian Fishes" collected by Spix, Agassiz had cherished the hope of some day exploring the basin of the Amazons and seeing Brazil. It may almost be called his hobby; and his relations with the Emperor of Brazil, with whom he had exchanged letters on scientific subjects, so much increased his desire that he resolved at the beginning of 1865 to carry out his plan of a visit to Rio Janeiro. His health had been gradually giving way ever since his illness at Charleston in 1853; and the attack he suffered at Cambridge in 1863 made it important for him to seek a change of scene and climate, with rest from work. Brazil was his lifelong desire, and towards

it he bent all his energy. Mr. Nathaniel Thayer, a friend, and at the same time one of the richest men of Boston, whom Agassiz had succeeded in enlisting as treasurer of the board of trustees of the Museum of Comparative Zoölogy, provided most liberally for six assistants and all the expense of collecting and forwarding the specimens to the Museum.

Agassiz embarked at New York, on the 2d of April, 1865, and arrived at Rio Janeiro the 22d of the same month. He was accompanied by his wife, Burkhardt as artist, J. G. Anthony as conchologist, Frederick C. Hartt and Orestes St. John as geologists, J. A. Allen as ornithologist, and a preparator. Besides these, six volunteer assistants, among them Mr. William James, had joined the expedition. The journey lasted sixteen months, ten of which were passed on the Amazons. Two of the assistants, Anthony and Allen, were soon compelled by poor health to leave for home. The artist, Burkhardt, although a constant sufferer during the whole trip, bravely continued his work until the end, drawing living fishes in their natural colours. But the exertion was too much for him; and this faithful companion of Agassiz returned home with such impaired health that after ten months of sickness at Cambridge, he died in the house of Mrs. Pauline Shaw, née Agassiz, whose kind heart and grateful remembrance of many kindnesses bestowed on her by Burkhardt when a child and a young lady drew her to the sick-bed of the old man, whence she took him in her carriage to her beautiful home in Jamaica Plain, where Burkhardt breathed his last, after a few days of the

most affectionate nursing and tender attention from his hostess.

Dom Pedro Secundo, Emperor of Brazil, received Agassiz in the kindest and most liberal and generous manner. It was a great pleasure for him, a scientific *dilettante*, to receive such a naturalist under his roof and in his empire. Educated partly in Switzerland, Dom Pedro had heard of Agassiz's researches on the glaciers and on fishes; and as his turn of mind was decidedly scientific, he had read more of Agassiz's works than any one else in Brazil. From their first meeting the two men were friends. His Majesty enjoyed Agassiz's immense store of knowledge, his brilliant spirit, and the charm of his conversation, while Agassiz, on his part, was rather surprised to find a crowned head so well instructed in geology, the glacial theory, and other scientific questions. Dom Pedro rendered every possible aid to the expedition; and from the time Agassiz put his foot on Brazilian soil until he left, the Emperor showed his great interest in the success and comfort of Agassiz and his party, and in these respects he succeeded admirably.

As soon as he arrived, Agassiz divided his party into several smaller ones, some to go to the interior, others to explore the coast; and as usual with him, and at the request of the Emperor, he delivered a course of lectures, open to all, without charge, at the Collegio Dom Pedro II, before a very large audience of gentlemen and ladies, headed by the Emperor with his whole family. Agassiz spoke in French; and it was a great pleasure to him to address an audience in his native

tongue, after so many years of constant lecturing in the English language, of which he was never a complete master. After a visit by railroad to the province of Minas-Geraes, Agassiz sailed from Rio, the 25th of July, for his Amazonian journey. The Emperor had detailed Major Joâo M. da Silva Coutinho of the engineer corps to accompany Agassiz during his whole exploration, — an admirable selection; for no Brazilian was better acquainted with the region of the Amazons River than he, having been engaged there for several years in scientific surveys. "His assistance was invaluable to us throughout the journey," says Agassiz; "and he became my intimate associate in all my scientific undertakings in Brazil. During eleven months of the most intimate companionship I had daily cause to be grateful for the chance which had thrown us together. I found in Major Coutinho an able collaborator, untiring in his activity and devotion to scientific aims, an admirable guide, and a friend whose regard I trust I shall ever retain."

The attachment was reciprocated by Coutinho, who became a great admirer of Agassiz. A Brazilian by birth and education, he was very fond of the wild Indian life of the tropical forests, and acted during all Agassiz's journey on the Amazons as an Indian scout looking after natural history specimens. In one of his rambles he put his foot on a big boa-constrictor, taking it for an old log fallen across the path. An unusual noise above his head put him on his guard and notified him of his mistake, but he did not choose to follow the beast into the swampy thicket. Coutinho was one of

the most progressive men in Brazil. He was one of the promoters of the construction of railroads in all parts of the country, and distinguished himself greatly as a government engineer. I became very strongly attached to Coutinho afterward at Paris in 1867, 1868, and 1877, and appreciated highly the charm of his society as a geologist, geographer, and friend. He died in Paris, October 11, 1890, while yet in middle life, from an illness contracted in the unhealthy wilderness of the Brazilian seacoasts, during his railroad surveys.

In the following paragraph I quote Agassiz's words in regard to his expedition : —

> Once in the waters of the great river (the Amazons), I divided my forces, in order to survey simultaneously various parts of this vast fresh-water system, wishing to ascertain how far the distribution of its inhabitants was local, or whether the same species might be found at the same moment in different parts of the main stream and its tributaries. This precaution led to results which amazed me, though I was in part prepared for it by my knowledge of their aquatic fauna. Not only did I find the number of species in these waters exceeding by thousands all former estimates, but I found their location so precise and definite, that new combinations occurred at given intervals along the main stream, while every forest lake and all the lesser watercourses had their special fauna. I neglected no opportunity of verifying the accuracy of my results, visiting the same regions at different seasons of the year, repeating my collections that I might have the fullest means of comparison, and, as I have said, stationing my parties at considerable distances, in order that by making simultaneous collections, we should ascertain what was the range of the species ("Special Report of the Directors of the Museum of Comparative Zoölogy," in "Annual Report for 1866," p. 14; Boston, 1867).

The Amazonian Steamship Company placed a fine steamer, furnished with everything needed by the whole party, at Agassiz's disposition for one month, while later a ship of war was sent up by order of the Emperor for the use of Agassiz during the remainder of his stay in the waters of the Amazons, to replace the Company's steamer, and wherever Agassiz arrived he found that directions had been given to the local authorities to furnish him with canoes, men, and whatever else he might require for his scientific researches.

The first station on the Amazons was Pará, then Manaos, Tabatinga, and Teffé. An excursion was made on the Rio Negro as far as Pedreira, where the stones in the bed of the river were so numerous and large, that the channel was too dangerous for the war-steamer *Ibicuhy*.

To Agassiz, as well as to Bates, Wallace, and Martius, the valley of the Amazons seemed the paradise of naturalists. His enthusiasm and admiration of everything he met knew no bounds, while he busied himself in collecting animals of all sorts, plants, more especially all the palms and ethnological specimens, and observed with his keen and searching eyes everything from men to insects. He filled to its utmost capacity with specimens the war-steamer, even the deck being encumbered with trunks of palm trees. For him the basin of the Amazons was a "fresh-water ocean," with an archipelago of islands. The character of its fauna is also oceanic, and its most noticeable feature is the abundance of cetaceans through its whole extent.

The health of Agassiz during his stay on the Ama-

zons was good, but it is no wonder that at last he was overcome by fatigue, and though not actually ill, was exhausted by incessant work, and by the contemplation, each day more vivid and impressive, of the grandeur and beauty of tropical nature. On his return to Pará, where he arrived in February, 1866, he was so tired as to be unable for several days to exert himself even to write letters. The climate had affected and enervated him more than he had at first thought. If Agassiz had made an exploration of the Amazons thirty years before, when still in the prime of life, the results would have been very different. Although he had undoubtedly acquired great practical experience on all zoölogical questions, and made good use of that experience during his journey up and down the great Amazons, he was too old to make a full use of his rare ability as an observer. His mind was no longer so elastic as at the time of his sojourn on the glacier of the Aar, and although his eagerness to collect specimens was as great as ever, he had no longer the bodily strength to make full use of them.

Certainly his "Brazilian expedition, fitted out and sustained by individual generosity, was treated as a national undertaking, and welcomed by a national hospitality," and Agassiz succeeded in bringing safely home to his museum the treasures he accumulated in Brazil; but it remained to work them up, to classify them systematically, and, as he himself says, "a critical examination of more than eighty thousand specimens cannot be made in less than several years." Unhappily this critical examination, for some reason or other,

was not only never finished, but was hardly begun, except some years later in the case of the fishes only, by his assistant, Dr. Steindachner. This is much to be regretted; for if he had accomplished what he planned before he started on that expedition, it would have resulted in a great advance in our knowledge of the geographical distribution of aquatic animals. In his own words, "One of my principal objects during the whole journey was to secure accurate information concerning the geographical distribution of the aquatic animals throughout the regions we visited. Upon this subject we had little precise knowledge, — even the best known among the fishes, reptiles, etc., of the Brazilian waters being entered in our zoölogical records simply as living in Brazil, or more generally still, as found in South America. As the distribution of species lies at the very foundation of the question of their origin, I have aimed at ascertaining as far as possible what are the areas and limits of their localization." It is a pity that he did not accomplish this localization!

Before leaving Pará, Agassiz delivered a lecture on the physical history of the valley of the Amazons, which was afterwards published in "The Atlantic Monthly," Vol. XVIII., July, August, 1866, pp. 49–60, 159–169, and reprinted in "A Journey in Brazil," Boston, 1868. The month of April, 1866, was devoted to an exploration of the province of Ceará, with the special purpose of looking for traces of ancient glaciers. The time was not propitious; it was the rainy season, and it was not easy to reach the Sierra of Aratanha in the interior of the province. However, Agassiz succeeded

in finding the glacial phenomena as legible as in any of the valleys of Maine, or even the Cumberland Mountains of England, with medial, lateral, and frontal moraines, at a level of only eight hundred feet above the sea in latitude four degrees south.

The roads in Ceará, during the rainy season, are so bad that the only way to travel is on horseback. This was the only time that Agassiz ever rode, and it was so trying and disagreeable to him, that he made most of the journey, especially the mountain scramble, on foot, notwithstanding the mud and the consequent pitching, tumbling, and sliding. He never repeated the experience, and nothing could have induced him then to mount a horse but his great desire to see moraines under the tropics.

By the end of April Agassiz was back again at Rio Janeiro. During the month of May he delivered at the Collegio de Pedro II, a series of six lectures, which was attended by the *élite* of society, ladies as well as gentlemen. It seems that before Agassiz came to Brazil ladies did not make their appearance at public lectures. It was certainly a progress in Brazilian customs that senhoras were allowed to follow a course of lectures, and Agassiz was much pleased with the sympathetic reception given by his Brazilian audiences. The lectures, delivered in French, were stenographically reported, were then translated into Portuguese by the French naturalist, M. Felix Vogeli, and published under his direction at Rio, bearing the title, "Conversações Scientificas sobre o Amazonas," and had a large circulation.

A last excursion in the vicinity of Rio to the Organ Mountains during June terminated Agassiz's journey in Brazil. He embarked the second of July for the United States, and arrived in Cambridge in August, 1866.

The main results of the Brazil expedition were, first, the great collections of all sorts, which were stored in the Agassiz Museum, awaiting final arrangement; second, two series of lectures at the Lowell Institute, in Boston, and at the Cooper Institute in New York, on the scientific generalizations growing out of the expedition; third, a volume of five hundred pages, entitled, "A Journey in Brazil, by Professor and Mrs. Louis Agassiz," Boston, 1868, with a French translation by F. Vogeli,[1] Paris, 1869; and fourth, a few articles published in reviews, and in the "Bulletin Société Géologique de France" — these last on the geology and with the collaboration of Coutinho and the present writer.[2]

The "Journey in Brazil" was a disappointment to the public in general, and more especially to the naturalists and personal friends of Agassiz. "The Naturalist on the River Amazons," by H. W. Bates, a work of genius, had somewhat spoiled the Amazons as a field of research, and had led people to expect more important

[1] The French edition is more complete and more valuable than the English, containing three times as many illustrations and maps and also some additional notes.

[2] "Lettre de M. Agassiz à M. Marcou sur la géologie de la vallée de l'Amazone, avec des remarques de M. Jules Marcou" ("Bull. Soc. Géol. France," Vol. XXIV., p. 12, December, 1866). "Sur la géologie de l'Amazone," par Agassiz et Coutinho, with notes by Marcou ("Bull. Soc. Géol. France," Vol. XXV., p. 685, May, 1868).

results from a naturalist of such repute as Agassiz. It is true that Bates remained there eleven years, while Agassiz passed only ten months, but the store of knowledge possessed by both was so different, that it was natural to expect not only something startling, but also something which might have some effect on the theory of the origin of species, in a Cuvierian way. The only part which can be called Cuvierian is an appendix on "The Permanence of Characteristics in Different Human Species."

In Agassiz's volume the personal adventures and incidents of travel are rather tame and the style dull and heavy, not in harmony with the usual brilliancy and spirit of the great naturalist, while in Bates's volume the narrative is most attractive, whether he speaks of adventures, incidents, or purely scientific matter, and the style full of animation. The difference is due mainly to their mode of travelling, one journeyed in state, as it were, while the other, alone, and with very scanty, sometimes without any pecuniary means at his disposal, forced his way with great difficulty. Besides, Bates was there in his prime, and wrote his volume himself.

However, Agassiz's influence on the progress of natural history in Brazil was very great, so far as anything makes a lasting impression upon a population inhabiting such a warm climate; for we must not forget the *dolce far niente* of the inhabitants of tropical regions.

It is interesting to see how Agassiz was influenced by what he observed during his Brazilian journey, in

regard to the origin of species, for he visited exactly the same ground that Henry W. Bates and Alfred R. Wallace had visited a few years before. In a letter to his old friend the ichthyologist, Sir Philip de Grey Egerton, dated Cambridge, March 26, 1867, Agassiz says, "I have about eighteen hundred new species of fishes from the basin of the Amazons! . . . It suggests at once the idea that either the other rivers of the world have been very indifferently explored, or that tropical America nourishes a variety of animals unknown to other regions. . . . My recent studies have made me more adverse than ever to the new scientific doctrines which are flourishing now in England. This sensational zeal reminds me of what I experienced as a young man in Germany, when the physio-philosophy of Oken had invaded every centre of scientific activity, and yet, what is there left of it? I trust to outlive this mania also. As usual, I do not ask beforehand what you think of it, and I may have put my hand into a hornets' nest, but you know your old friend Agassiz, and will forgive him if he hits a tender spot." [1]

Until the end of his life Agassiz considered "the transmutation theory as a scientific mistake, untrue in its facts, unscientific in its method, and mischievous in its tendency" ("On the Origin of Species" in "American Journal of Science and Arts," Vol. XXX., July, 1860, p. 15).

It is just to say that the sixteen months spent in Brazil were among the most happy of Agassiz's life.

[1] "Louis Agassiz," by Mrs. E. C. Agassiz, Vol. II., pp. 646-647.

He enjoyed everything immensely, was never sick, only now and then tired through over-exertion and excitement, was received with open arms by every one, from the Emperor to planters, traders, etc., and for the first time in his life was unembarrassed financially, being amply supplied with money by Mr. Nathaniel Thayer. Besides this, his wife at his side always took upon herself a great part of the management, and shared his comfort and fatigues, and was the recipient of many complimentary attentions on the part of the Brazilian population. Altogether it was a sort of triumphal scientific exploration, certainly merited after the many years of hard work in Europe and in America of one who concentrated in himself the careful and original studies of almost half a century. No naturalist more deserved such a reception than Louis Agassiz.

General incidents in Agassiz's life, which happened before his journey to Brazil, have been passed over, in order not to break the narration of more important events. Among these we may mention the receipt of the Copley Medal, awarded to him in December, 1861, by the Royal Society of London, — an honour which pleased Agassiz much, and which is considered by the English savants as the highest reward they can bestow on a foreigner or a native. It was certainly well placed this time, for few of its recipients have done so much for the progress of natural history in both hemispheres.

Not long after the outbreak of the Civil War, in 1861, in its darkest hour, Agassiz took out naturalization papers, to show his sympathy with the Union. Until this time he had kept his Swiss nationality, notwith-

standing his acceptance of various positions and offices in America. He felt indignant at the action of England and France in recognizing the Southern Confederacy, and did his best to open the eyes of certain European officials in this country to the right side of the question and the final results.

In March, 1863, during a session of the Board of Regents of the Smithsonian Institution, he joined Professor Bache in his scheme for the foundation of a National Academy of Science. Bache was a rather ambitious man, full of academic distinctions, and a lover of power. In 1860 Agassiz had him elected a corresponding member of the Academy of Science of the Institute of France, and from that moment Bache worked at the creation of a National Academy, to bear some analogy to the French one. Under the pretext that the government in Washington might be in want of advice, directions, and reports on scientific subjects, Bache, supported by Agassiz and Joseph Henry, obtained, through Henry Wilson, then Vice-President of the United States, an act by the Thirty-seventh Congress "to incorporate the National Academy of Science."

Agassiz, who knew the defects of close corporations with government privileges, like the Institute of France, hesitated in following Bache, as did Joseph Henry. But both had been in such intimate relationship with Bache, and the American Association for the Advancement of Science, founded in 1848, had given such scanty results, notwithstanding the influence exerted on the committee by Professor Bache and his friends, that

they thought a trial might be made. Agassiz may be called one of the founders, but not the "prime mover." Returning from Washington, after the act was passed by Congress, Agassiz was certainly not an enthusiast on the subject, and even showed a dislike to talk about it, simply saying that "the National Academy was mainly to satisfy Bache's ambition for control." A friend told him that it would soon fall into the hands of politico-savants, which he admitted might be true; and, in fact, a few years after the death of Bache, Agassiz, and Henry, the National Academy of Science became, as predicted, a tool in the hands of ambitious government employees at Washington.

In 1864, before Agassiz's journey to Brazil, Dr. Brown-Séquard had taken up his residence at Cambridge, as professor in the Medical School of Harvard; and a friendship based on mutual admiration soon sprang up between them. After his return the relations became very close, and Agassiz urged Brown-Séquard to go to Paris as the best place to prosecute his physiological researches. He gave him very strong recommendations, advising the Minister of Public Instruction to create a special professorship at the Medical School. Armed with these letters of Agassiz, Dr. Brown-Séquard went to Paris at the end of 1867, and was soon appointed professor of physiology in the medical faculty, a new chair created in his favour; and later he succeeded the great physiologist, Claude Bernard, at the "Collége de France" and at the Academy of Science of the French National Institute.

Some of Agassiz's pupils have already been referred

to; others, added from time to time, require special mention. Among the assistants whom he took to Brazil were Hartt, Saint John, and William James, all three noteworthy naturalists. Charles Frederick Hartt came to Cambridge in 1862, for instruction at the Agassiz Museum. He was already in advance of all the other students as a practical geologist, having worked steadily and intelligently at the geology of a part of Nova Scotia and New Brunswick. I at once saw his value, and followed his work with interest. Although a member of Agassiz's party in Brazil, he did little in the geological field, because the special part of Brazil assigned to him was devoid of fossil remains; but he conceived a desire to see more of the country, and returned to it in 1867. This time he had greater success; and about Bahia and Sergipe he collected many fossils, and really began his geological survey of Brazil. In 1868, having been appointed professor of geology in the new Cornell University, on the recommendation of Agassiz, he organized a third expedition to Brazil in 1871; and in company with some of his pupils, he explored the Amazons River region. On this occasion he succeeded in discovering the Devonian system at Monte Alegre and Sierra Ereré, and extending the area of the Cretaceous rocks between Pará and Pernambuco. In these two expeditions Hartt showed his great capacity as an observer and a leader. After the death of Agassiz he submitted to the Brazilian government a plan for a systematic geological survey of Brazil, which was accepted. Having been consulted, I did not hesitate to recommend the scheme to the

Emperor Dom Pedro; and in 1877, in Paris, the Emperor thanked me, saying how highly he appreciated Hartt and his assistants, Orville A. Derby, R. Rathbun, and J. Branner, "all very able and conscientious young savants," as he expressed it. Unhappily yellow fever killed Hartt in March, 1878, after only two years of work on the geological survey of Brazil, which was discontinued.

Orestes H. Saint John, another of Agassiz's assistants on the Brazilian journey, is the only student of fossil fishes that Agassiz had in America. An extremely modest man, Saint John has since distinguished himself by the publication of memoirs of great value on the fossil fishes of Illinois and other Western states, and stratigraphical researches on the state of Kansas.

As to William James, a gifted member of a gifted family, his journey to Brazil and up the Amazons developed his keen power of observation, in a psychological direction and in the philosophical realm, and he has since been made one of the professors of philosophy at Harvard University, and become one of the most enlightened disciples of the Charcot school of psychology.

Samuel H. Scudder, the author of the charming sketch, "In the Laboratory with Agassiz," is one of the best pupils, and perhaps the most devoted naturalist, who studied under Agassiz. He has devoted his life to American entomology, living and fossil, and has published standard and most beautiful works on these subjects. Fossil insects, more especially, have been his favourite study for many years, and we may

truly say that he is the American palæo-entomologist *par excellence*.

John B. Perry came to Cambridge among the last of Agassiz's pupils and assistants. I had met him at Swanton, Vermont, in 1861, where he was a pastor of the Congregational church, and was much impressed by his capacity as an observer in practical geology. He was my constant companion during all my researches on the Taconic system, in Vermont and North-eastern New York, and, as his biographer says, my "friendship was the great turning-point in Mr. Perry's future." He rapidly became a good palæontologist, and in 1868 left the ministry to accept a position as assistant in the Agassiz Museum. But Perry did not live long; during a protracted excursion in the Southern States, during the summer of 1872, in search of Tertiary fossils, he contracted malaria, and died of it at Cambridge in October, 1872. He was a man whose honest and modest diligence as a geologist Agassiz highly appreciated.

During the fall of 1867 Agassiz lost his mother, — the heaviest sorrow of his life. She died at Montagny on November 11, at the age of eighty-four years. "Madame la pasteur Agassiz," as she was called in Switzerland, was a most remarkable lady, superior to all her surroundings. Every one loved her, and she was respected as few women ever were. Her son Louis was her favourite child, and in her Agassiz found a profound maternal love, comforting him in all his trouble, giving gentle counsel, never discouraged, but always hoping for better times to come. Mother-like,

she kept her interest in all his work in America, looked over all his publications in the English language, although she did not understand English, and every volume and every paper received from the other side of the Atlantic from her dear Louis was carefully treasured by her.

CHAPTER XXI.

1868–1870.

THREE LETTERS TO JULES MARCOU — SHORT JOURNEY TO THE ROCKY MOUNTAINS — STORY OF THE FIRST DISCOVERY OF THE GREAT FOSSIL VERTEBRATE LOCALITY NEAR FORT BRIDGER — CORNELL UNIVERSITY — OPINIONS OF CHARLES DARWIN, THOMAS HUXLEY, AND J. TYNDALL ON AGASSIZ'S GREAT WORTH — HIS LACK OF JUDGMENT IN CHOOSING HIS ASSOCIATES — ADDITIONAL BUILDING AT THE MUSEUM — THE RESULT OF ITS FIRST TEN YEARS — DEEP-SEA DREDGING ON THE STEAMER "BIBB" — THE "POURTALÈS PLATEAU" — THE CENTENNIAL ANNIVERSARY OF THE BIRTH OF ALEXANDER VON HUMBOLDT — AN APOPLECTIC ATTACK — A LONG CONVALESCENCE — THE FRANCO-GERMAN WAR.

THE activity of Agassiz in scientific lines knew no bounds, as will be seen from the following extracts from some of his letters to me, written during 1868.

CAMBRIDGE, MASS., le 13 mars, 1868.

Mon cher Marcou, — Vous savez peut-être que Mr. Peabody, le banquier américain à Londres a donné à notre Université une somme de 150,000 dollars pour fonder un musée ethnographique. Tôt après cette donation je me suis mis en campagne pour engager les "Trustees" au nombre desquels est Mr. R. C. Winthrop, aujourd'hui en Europe, à faire quelque grande acquisition comme point de départ. J'ai d'abord recommandé la collection du Colonel Schwab (Switzerland) ; je vais presser celle (de Gabriel de Mortillet) que vous me recommandez, et si le Musée était déjà organisé je ne doute pas que la chose ne se fit, mais tout est encore en question, jusqu'à l'emplacement à choisir pour y déposer les collections.

Votre lettre du 24 février a trait à mes "Principles of Zoölogy." Je n'ai jamais reçu de communication à ce sujet, ni de votre ami M. Reclus, ni de son éditeur M. Hetzel. Ce sont de ces choses auxquelles on n'est pas indifférent et je verrais avec plaisir ce livre traduit en français; mais il a besoin d'être revu. Plusieurs chapitres sont vieillis et bien qu'il en ait paru plusieurs éditions ici, je n'y ai jamais fait de retouches.

Votre dévoué,

Ls. AGASSIZ.

The Hon. Robert C. Winthrop visited me in Paris, and asked my help in the purchase of de Mortillet's collection. The transaction was successfully made, and I superintended the packing of the collection, after receiving it into my charge, happy to have another opportunity to help Harvard University. The elementary treatise on zoölogy, although translated by Elisée Reclus as far back as 1867, was not published until 1891, when it appeared in Hetzel's "Magasin d'Education et de Récréation," under the title, "Principes de Zoölogie, par L. Agassiz et Gould, traduit par Elisée Reclus." This reprinting of the work forty-three years after its original publication shows how highly it was appreciated, and is unique in the case of an elementary book, treating of so variable a science as zoölogy.

NAHANT, le 4 juillet, 1868.

Mon cher Marcou, — Vous aurez peut-être appris que j'ai fait une grosse maladie qui a failli m'enlever et dont je me remets lentement. Toute application m'est interdite; seulement je voudrois, s'il en est encore temps, m'assurer la collection de Poirrier. Veuillez dire à sa veuve que si elle n'a pas conclu avec Mr. Cope, je la prie de me donner la préférence, puisque j'ai été en négociation pour cette collections avant lui.

Encore une demande. La Législature [of Massachusetts] vient

de m'accorder une forte somme pour étendre le Musée et je voudrois y attacher un mouleur de première force. Voudriez-vous voir Stahl au Jardin des Plantes et lui demander s'il serait disposé à venir me rejoindre; et si non, peut-être a t'il formé quelqu'élève qu'il pourrait me recommander consciencieusement pour faire des travaux délicats, aussi bien que des moules de grands ossements fossiles. Faites lui en même temps mes amitiés.

Dès que je serai moins affecté par la position nécessaire pour écrire qui me suffoque, je reprendrai la plume plus longuement.

Bien à vous,

Ls. Agassiz.

This letter shows unmistakable signs of the difficulty Agassiz experienced in holding his pen. Indeed, I never received one from him so plainly indicating tremulousness.

His health, regained during his Brazilian journey, broke down again during the spring of 1868. The heart was affected this time, and Dr. Brown-Séquard ordered a complete cessation of cigar-smoking, — a great privation to Agassiz. He was not an easy invalid, being too full of schemes of all sorts, and very impatient of bodily inactivity.

The Poirrier collection, referred to in the above letter, was a rich collection of very rare vertebrates from the fresh-water Tertiary formation of Auvergne. I had to look at it attentively, at the request of Agassiz; but the death of M. Poirrier and the serious sickness of Agassiz prevented the purchase. The collection has been secured since by Mr. Cope, of Philadelphia, and, consequently, is in good hands.

M. Stahl, Agassiz's former modeller at Neuchâtel, trained with great care to the work of modelling fossil

fishes and other objects, had become so expert that the Jardin des Plantes of Paris would not part with him; and besides, he felt, as he told me, that he was too old to begin life again in America. However, Agassiz, with his usual persistency when he wanted anything connected with natural history, got a modeller, and created at his museum a studio where numerous specimens, especially of fossil bones, were modelled. But it proved too expensive, and at his death the studio work was discontinued.

UTICA, N.Y., le 10 août, 1868.

Mon cher Marcou. — Vous savez peut-être que j'ai fait une maladie grave et douloureuse l'hiver dernier. Ne me remettant pas assez vite pour pouvoir espérer de reprendre mon travail l'hiver prochain en restant à Nahant, où je suis harcelé de visites, je me suis mis en route pour les Montagnes Rocheuses, et me voici à Utica, où je passe le dimanche, occupé à étudier votre Géologie et carte géologique de l'Amérique du Nord.

Pendant mon voyage je m'appliquerai surtout à étudier l'influence que les Montagnes Rocheuses ont eue sur les phénomènes erratiques durant l'époque glaciale; c'est un point de la question qui n'a pas encore été touché. J'étudierai aussi le lit de nos fleuves, dont les dimensions se rattachent aussi à cette question. Comme je l'ai été à l'origine, je veux, si possible rester à l'avant-garde pour tout ce qui touche à ce sujet. Quoiqu'on cherche à la rapetisser, c'est après tout une des plus grandes questions de la géologie et quoiqu'en dise les envieux c'est moi qui l'ai soulevée et développée.

La part de Charpentier est d'avoir mis en évidence la plus grande extension des glaciers des Alpes. Il ne s'est jamais avisé d'y voir un phénomène général indiquant des changements profonds dans la température du globe. J'ai été surpris de voir que bien des géologues sont disposés à lui faire honneur aussi de ma part de la question. . . .

Adieu, mon cher Marcou, au revoir.

LS. AGASSIZ.

This letter is doubly interesting: first, because it shows that the great and wonderful memory of Agassiz was on the decline, for he had forgotten his preceding letter in regard to the state of his health; second, because it expresses his feeling about the glacial question and the studied neglect of some, who affected to pass over the great part he had taken in it, from the start.

In 1868, a short journey to the Rocky Mountains was made on the invitation of Mr. Samuel Hooper, then member of Congress for Massachusetts, to see the progress made in the construction of the Union Pacific Railroad. General Sherman, commander-in-chief of the army, joined the party with ambulances and an escort of cavalry for conveyance across a part of the Kansas and Nebraska prairies. The road was built only as far as the Green River station, in Wyoming, where the laying of rails had brought to view a bed of limestone full of fossil fishes and insects. Agassiz was delighted by the discovery, and, if he had been fifteen years younger, he would never have stopped at Green River station and thence turned eastward without a visit, strongly urged upon him by Judge Carter, of Fort Bridger, to the Grizzly Bear Buttes, so celebrated since as the richest locality for fossil vertebrates of the Oligocene period. Judge Carter, the sutler at Fort Bridger, met the party at Green River, and related to Agassiz, how an old trapper, Jack Robinson, had repeatedly reported to him that he knew several places, at the foot of the Uintah Mountains, where grizzly bears were changed into stone, the bones being as hard and heavy as rocks; and, in order to convince Judge Carter,

the trapper one day brought a bag full of these fossil bones, which he threw down on the floor at his feet. To his surprise, he saw a well-preserved skull, resembling that of a bear, which has since been described by Dr. Leidy as *Palæosyops*.

If Agassiz had accepted the hospitality and help most generously offered by Judge Carter, he would have anticipated the discovery, made the year after, in 1869, by Hayden's exploring party. But Agassiz was too old and not strong enough to undertake a horseback ride of sixty miles to reach Fort Bridger. His experience on horseback the year previous, in the province of Ceará, in Brazil, had entirely disgusted him with this mode of conveyance, and he firmly declined Judge Carter's invitation.

This is another instance of the singular case of atavism of his ancestors, the lake-dwellers of Switzerland. Like them, Agassiz would go on any kind of boat, however unsafe it might be; but on land he trusted only his legs.

When, in 1875, during an exploration round Fort Bridger, I told Judge Carter of the strong aversion Agassiz had to riding horseback, he exclaimed, "Oh! if I had been aware of it, I would have brought with me an ambulance, for I wanted so much to show him the specimens."

On his return to Cambridge, Agassiz stopped at Cornell University, which was about to be inaugurated, and where he had accepted an appointment as non-resident professor. He assisted at the opening of the University, and made one of his charac-

teristic speeches, entering most heartily into the new enterprise, pledging it his support, and giving most valuable hints as to the proper lines of development. With his optimistic tendency, Agassiz took a great fancy to the idea of a university combining the artisan with the student, manual labour with scientific work. He came back from Ithaca, the seat of the Cornell University, with the most exaggerated views in regard to the future of the new institution, speaking of the backwardness of Harvard, and prophesying that Cornell would soon leave Harvard far behind. In his enthusiasm for a new plan, Agassiz was apt to go too far. He seemed to forget entirely that an old university like Harvard must always possess an amount and kind of interest which a new university cannot have. A university is the work of time; and money and new plans cannot take the place of the long series of accessions, material as well as intellectual, which has enriched Cambridge during more than two centuries.

A letter to Agassiz from the poet Longfellow, then travelling with his family in Europe, gives me an opportunity to recall several facts, all to the honour of Agassiz, as contributions, coming either from scientific adversaries like Darwin and Huxley or from admirers like Tyndall. On meeting Longfellow at the Isle of Wight, Darwin said to him, "What a set of men you have in Cambridge! Both our universities [meaning Cambridge and Oxford] put together cannot furnish the like. Why, there is Agassiz—he counts for three." Coming from Darwin, the compliment is no small one, for Agassiz had opposed his "Origin of Species" in

undisguised terms for eight years. A few months after, at the Athenæum Club in London, Thomas Huxley said to me, "Agassiz is a backwoodsman in natural history. He clears up the forest, cutting down all errors, theories, without regard to persons or established reputation. What a pioneer!"

Some years before, at the meeting of the Swiss naturalists at Geneva, in 1865, I heard John Tyndall say, "If Bishop Rendu had been a physicist, he would have left nothing for me to do; for after the experiments of Agassiz on the Aar glacier, all the main facts of the glacier motion and mechanism were so well established as to leave nothing but a question of pure physics, which was as nearly as possible solved by Rendu's theory." Tyndall expressed, without reserve, his admiration of Agassiz's work, and his dissent from James Forbes's theory and claims in regard to the structure of ice.

Agassiz was never a good judge of character; and he too often associated with himself persons either unfit for the work assigned to them, or not in a condition to render the services expected. He was too easily led by flattery, and was apt to trust any one who made a show of devotion to the progress of science, and spoke grandiloquently of the sanctity of the sacred office of carrying on researches in various scientific fields. He was imposed upon by the airs assumed by a certain number of half savants, who are to be found everywhere, but in greater number in America, where they have received the name "Almighty Savants."

His professorship of zoölogy and geology, on his

proposition, was successively divided into three separate chairs; a chair of geology, a chair of palæontology, and a chair of zoölogy. At the time of his death neither of the incumbents were persons well fitted for the position for which they had been chosen.

The first mistake was the calling to the chair of geology of an indifferent observer. We know how Agassiz was justly proud of his knowledge on glaciers and of being considered as the father of the "Ice-age." What did his successor do but publish, in 1882, a long and diffuse paper entitled, "The climatic changes of later geological times," in Volume VII. of the "Memoirs of the Museum of Comparative Zoölogy," founded by Agassiz, in which he attempts to nullify his greatest discovery in geology. It is almost incredible that at this time of our knowledge of glaciers and the glacial question a person has called the "Ice-age" a myth, saying, pp. 387 and 388 in the paper quoted above: "The so-called glacial epoch . . . the glacial epoch was a local phenomenon," just the reverse of the discovery and teaching of Agassiz. The same person, after ascending Mount Shasta in California, and exploring the Sierra Nevada, has the boldness to emphatically declare that no glaciers exist now at either Mount Shasta or in the Sierra Nevada, where we all know they may be counted by the half-dozen.

The second mistake was his choice for the chair of palæontology. Agassiz formed some pupils who greatly honour his teaching in palæontology. It is sufficient to name such able American palæontologists as Alpheus Hyatt, Samuel H. Scudder, and Orestes St. John. But

instead of choosing one of these, he appointed another pupil, who after a futile attempt at work on the Brachiopoda, took to teaching geology. After some years his official position of professor of palæontology became so embarrassing, even to himself, that he asked to have his title changed to professor of geology.

Finally, the third mistake was the appointment of a third-rate zoölogist for the chair of zoölogy. After a few years the incumbent retired.

The preceding details are necessary in order to show a foible in Agassiz's character, and how some of his greatest efforts and successes were partly paralyzed by his choice of associates and substitutes in zoölogy, palæontology, and geology.

It had become an absolute necessity to increase the financial resources of the Museum; for the constant addition of specimens involved such expense that it was almost impossible to carry on active operations even in the most meagre way. In 1867, Agassiz obtained a grant of ten thousand dollars from the Legislature of Massachusetts, and from the American Congress the remittance of excise duty on alcohol used for scientific purposes; and again in 1868, the Legislature granted seventy-five thousand dollars for an extension of the building, and private individuals subscribed a similar sum. Work was begun at once, and two-fifths of the north wing was added to the two-fifths already standing. It was impossible to do more at the moment, and the final fifth of the north wing was left to be added at some future time.

Over four hundred and seventy-three thousand dol-

lars had been expended on the Agassiz Museum from the time of its organization in 1859; certainly a large sum, but not too large, if we consider the results arrived at. As Agassiz justly says: "It is an astonishment and a gratification to me to find that in ten years we have attained a position which brings us into the most intimate relations with the first museums of Europe; we have a system of exchanges with like establishments over the whole world; while the activity of original researches in our institution, and its well-sustained publications, the possibility of which we owe to the liberality of the Legislature, make it one of the acknowledged centres of the scientific progress. . . . I claim that its results, as compared with those of other institutions, are in more than due proportion to the money expended. . . . The organization must, of course, be the work of the director; but for the energetic and intelligent carrying out of the scheme, I have to thank the gentlemen working with me either as assistants upon very moderate salaries, or as friends of the institution who give their work without any renumeration whatever.[1] . . . From the earliest organization of the Museum, I have had three great objects in view. First, to express in material forms the present state of our knowledge of the animal kingdom; second, to make it a centre of original research, where men who were engaged in studying the problems connected with natural history should find all they needed for comparative investigations; thirdly, — and this last

[1] "Report of the Director of the Museum of Comparative Zoölogy" for the year 1869.

object has been by no means less prominent than the two others, but, if possible, has engrossed my thoughts more, — to make it an educational institution; to give it a widespread influence upon the study, the love, and the knowledge of nature throughout the country. . . . I have laboured under many obstacles in the carrying out of this scheme. Often, for want of means to pay salaries, the assistants have been so few, and their knowledge so immature, that it was impossible to organize any extensive scheme of instruction." [1]

During the spring of 1869 Agassiz joined Pourtalès on the United States coast survey steamer *Bibb*, engaged in deep-sea dredging between Florida, Cuba, and the Bahama Islands. Dr. William Stimpson, a favourite pupil of Agassiz, had inaugurated dredging for marine animals along the New England coasts, but to Pourtalès are due the systematic investigations of the beds of the Atlantic Ocean, on the American side, having for their aim the fauna existing at different depths. In the two years 1867 and 1868, Pourtalès had succeeded so far as to leave no doubt that "animal life exists at great depths in as great a diversity and as great an abundance as in shallow water."

Agassiz in his "Report upon Deep-sea Dredgings in the Gulf Stream, during the Third Cruise of the United States Steamer *Bibb*," Cambridge, November, 1869, says, pp. 363 and 367: "The object of my own connection with the present cruise was to ascertain how far the last investigations covered the ground to be surveyed, and to what

[1] "Report of the Director of the Museum of Comparative Zoölogy" for the year 1868.

extent and in what direction further researches of the kind were desirable in the same region, and likely to furnish important information. . . . It is a pleasure to me to state that our cruise — extending farther to the east in the Gulf Stream, between Cuba and the Bahamas on one side, and Florida on the other, than those of previous years — confirmed in every feature the conclusion already reached by M. Pourtalès. . . . Permit me a suggestion. . . . It would be appropriate and just that this extensive coral plateau, the characteristic fauna of which M. Pourtalès has so faithfully explored, should bear his name and be called the 'Pourtalès Plateau.'"

The Boston Society of Natural History proposed to celebrate the centennial anniversary of the birth of Alexander von Humboldt on the 14th of September, 1869, and appointed Agassiz orator of the day. He accepted the invitation with joy, and was grateful for the honour, because, as he says, he "loved and honoured the man." The address was delivered at the appointed time, in the Music Hall of Boston, before a crowded and brilliant audience comprising many persons of the highest culture and distinction in New England.

The choice of Agassiz was eminently proper, not only on account of the nature of the work done by Humboldt in the New World, but also because of Agassiz's personal intercourse with him, which began when Professor Oken wrote from Munich in 1829 to offer Agassiz's services as an assistant for Humboldt's journey in Central Asia. It was more especially during Agassiz's

stay in Paris, 1832, that he saw much of von Humboldt. Then the great traveller was at the zenith of his reputation and social success. He was the lion of all the political, literary, and scientific salons of the French capital. Humboldt was an admirable talker. He would converse for hour after hour, hardly taking time to breathe, keeping the whole circle of hearers collected round him, and hanging in suspense on his lips. He was a monologist *par excellence;* few people were bold enough to interrupt him, even by an exclamation of admiration or wonder. An anecdote will best show the great attraction exercised by von Humboldt upon all savants. His friend and companion at the School of Mines of Freiberg, Leopold von Buch, was so fond of hearing him that he could find nothing better to do than to waylay him as he left "les salons," during the winter of 1820 in Paris, walk home with him, and sit down and listen to him all night, from midnight until daybreak. The result was that von Buch suffered from an attack of pneumonia, and when reproved by his cousin, the young Count d'Arnim, for his imprudence, the answer was, "It is my fault. The open fire near which we were talking went out. I was very cold and chilly, but if I had made the slightest move to light it again, perhaps I would have caused Humboldt to leave me. I preferred to suffer and hear his conversation, and I am very glad of it, because I have gained much knowledge by it."

The only person in Paris who treated Humboldt as an equal and did not fear to interrupt him and even to make fun of him, was the great astronomer, François

Arago. One day he said to him before witnesses, one of whom repeated it to me, "You do not know how to write a book. When you begin a subject, you go, go, go, and cannot stop, just like your never-ending talk." ["Toi, Humboldt! tu ne sais pas écrire un livre; tu commences, va, va, va, tu ne peux plus t'arrêter; exactement comme tu parles."] Arago always *tutoyait* Humboldt, a custom dating from the French republic at the time of the *sans-culotte*, which was kept up for one or two generations among the savants, and even to this day among artists.

The address of Agassiz was admirable. It gave all the salient points of Humboldt's life; indicated his great influence on the progress of natural sciences during the first half of this century, and acknowledged the debt America owes to him as a discoverer in physical geography, — a science which it may be said was created by him, — and to his clear and exact exposition of everything relating to the natural history of the equinoctial regions of the New World. Humboldt was inclined to be sarcastic and was always ready to make fun of others, the only ones exempt from his rather sharp remarks, among his scientific contemporaries, being Arago and young Agassiz. Even the glacial doctrine, which he did not relish much, was treated respectfully by him, and he used it only against his old friend von Buch, who always lost his temper every time a reference was made to it.

To deliver his address, Agassiz had to leave the side of his dear and favourite child, Mrs. Pauline Shaw, then very ill and in a critical condition. The

great effort of preparing his elaborate address, its delivery before a large audience, combined with the sorrow due to his daughter's illness, proved too much for his brain; and soon after he broke down completely, and a very severe and dangerous attack of paralytic apoplexy disabled him for more than ten months. His speech was affected, he was unable to control his hands and hold anything, and physicians forbade every exertion, even thinking. This last privation was the most painful, and not easy to bear without constant desire to break the doctor's order. Lying on a lounge in his sick-room, he looked like a lion loaded with chains and encaged in an iron box. His splendid and strongly built body was no longer at the command of his will; his inquisitive, brilliant, and intelligent eyes followed closely every visitor, as if to inquire what they thought of his sickness. Vertigo was a constant menace. However, as soon as he could, he began to dictate notes in regard to the arrangement of the more recent collections received in his museum; and he called to his side some of his assistants, to confer with them regarding lectures and the application of a new and strict rule to each employee, compelling each to work seven hours a day purely for the benefit of the institution, no outside work, even of a scientific character, being allowed during that time.

In the spring of 1870, as soon as it was possible to remove him without too much risk, he left Cambridge for the small village of Deerfield, on the Connecticut River. There he improved rapidly; the vertigo symptoms soon disappeared, daily walking about the village

being the only "cure" he followed, with the relish of an old walker, accustomed since his life at Motiers, Orbe, and Concise to ramble in search of animals and plants. As soon as he could write, he began a correspondence with the trustees and his assistants at the Museum and his old scientific friends in Europe, showing how miraculously his health had recuperated, and activity returned into his frame, like the rebounding of an elastic ball. In November, 1870, he returned to his dear museum, and was able to resume his lectures.

Although Agassiz never meddled, or even troubled himself much, with politics, he followed with an intense interest the Franco-German War. The abuse of victory by the new German emperor particularly wounded him; he thought better of a Prussian king, and from the moment he read the autocratic and exacting terms of the peace forced on France by an ungenerous and impolitic victor, he turned against Germany, all his old French instincts and early impressions of the great services rendered to liberal ideas and science by France and Frenchmen coming back to his memory, and blotting out all the sympathies aroused during his student life in German universities. It was a complete reversion of sentiment, and he at once wrote a letter full of sympathy to his old friend, M. Thiers, then president of the French republic, receiving a most flattering letter of thanks some months later. Agassiz knew too well what was due to French influence in every department of human knowledge to accept all that was said against France and the French nation. His original Vaudois blood revolted, and from that moment, until his death,

he spoke openly of his sympathies and ardent feeling for a people which had rescued his native Canton de Vaud from Bernese tyranny and bondage, and is of the same Latin race, using the same language, — the language of Jean Jacques Rousseau, de La Harpe, Jomini, and Madame de Staël, and in which his own works on the "Poissons fossiles" and on the glaciers were written. The crisis brought up by the fall of France, added to old age, made him, by a sort of irresistible tendency, return naturally to the feelings of youth and of childhood, while those of middle age disappeared, and after 1871 Agassiz was more French than myself, at least in his feeling about the future of France.

CHAPTER XXII.

1871–1872.

Voyage on the "Hassler" — Dredging at the Barbadoes — Machinery of the "Hassler" — Prophetic Views in a Letter to Benjamin Pierce — Glaciers in the Strait of Magellan — From Talcahuana to Santiago by Carriage — Meeting of Domeyko and Philippi — Agassiz's Election as a Foreign Fellow of the Academy of Science of the Institute of France — The Galapagos Islands — Panama and San Francisco — Return to Cambridge — Another and the Last Series of Assistants at the Museum — Appropriations from the Legislature of Massachusetts.

Public life possesses such an attraction, and gets such a strong hold on any one who has drunk at the cup of popularity, that it is almost impossible to resist the temptation of maintaining a name which has once become celebrated on the world's stage. Great naturalists, like statesmen, artists, speculators, financiers, are no exception to the rule. Simple prudence, after the illness of 1870, would have easily prolonged Agassiz's life for a score of years, for he came from long-lived parents, his mother dying in the eighty-fifth year of her age. But Agassiz was not a man to step into comparative obscurity; he wanted applause, not only in the lecture-room, but also before the general public. The discovery of animals living at great depth on the bottom of the sea was so interesting that he was unable to

resist the desire for an investigation directed by himself in person.

His friend, Professor Benjamin Pierce, had succeeded Professor Bache as Director of the United States Coast Survey, and an expedition was easily arranged under his supervision. Frank de Pourtalès, who had passed the last five years in deep-sea dredgings for the Survey, was naturally put in charge of the apparatus for sounding and hauling the net from the bottom of the sea. A new steamer, built especially under the direction of the navy officer, Captain C. P. Patterson, chief hydrographer of the Coast Survey, and named the *Hassler* in honour of a Swiss mathematician of Aarau and the first director of the Coast Survey, was fitted for the voyage. It was a small steamer of three hundred and fifty tons, rigged as a three-masted schooner, one hundred and sixty-five feet long, twenty-five feet beam, ten feet depth of hold, and with a draught seven and a half feet forward and ten feet aft; but it was too hastily and imperfectly finished by the contractor, and was not a proper vessel for a long voyage. The compound engines, with double cylinders, the same used at that time on the White Star Line Company's transatlantic steamers, were unfit, and ought never to have been accepted. A lack of oversight, during the construction and at the reception of the little steamer, marred the whole expedition from its start until its arrival at San Francisco. It was a great, almost a cruel, carelessness to embark a man so distinguished, so old, and so much an invalid as Agassiz was, in an unseaworthy craft, sailing under the United States flag.

The crew and passengers numbered about fifty persons, the scientific party being composed of Professor Agassiz and his wife; Dr. Thomas Hill, ex-president of Harvard University; Frank de Pourtalès; Dr. Franz Steindachner, Agassiz's favourite assistant in ichthyology, and a draughtsman; and Commander P. C. Johnson, United States Navy, who was also accompanied by his wife, a native of Chili. Everything that could contribute to the comfort of Agassiz and his friends was provided.

After long delays, from the summer until the beginning of the winter, the *Hassler* at last sailed from Boston, the 4th of December, 1871, in a snowstorm, and with a heavy sea. During the first four days, the roughness of the voyage much fatigued Agassiz, who thought that he had undertaken a task beyond his physical strength. However, after passing Cape Hatteras and reaching the West Indies, he quickly rallied from the discouragement and depression which had seized him at the departure; and a very successful dredging, made in a depth of eighty fathoms near the coast of the Barbadoes, which brought up several stemmed crinoids, then a great rarity, delighted him so much that he soon forgot all the unpleasantness of the voyage.

Unhappily, the station near the island of Barbadoes was the only one of the whole expedition which was successful so far as number of sea-animals obtained was concerned It soon became evident that the engine of the *Hassler* was not only defective, but absolutely worthless; and the whole plan of the voyage, sketched with such a masterly hand, had to be modified and cur-

tailed. The *Hassler* was able merely to creep along the coast from one port to another, stopping at almost every one to allow her machinery to be repaired. She sailed from the Barbadoes to Pernambuco, thence to Rio Janeiro, Montevideo, Port of San Antonio, Strait of Magellan, Arenas, Port Famine, Glacier Bay, Sholl Bay, San Pedro, and finally to Talcahuana in Conception Bay, Chili, where she remained three weeks for the repair of her engine. Pourtalès dredged as often as practicable, and succeeded in collecting a large number of rare or unknown species.

Before embarking, December 2, Agassiz wrote "A Letter concerning Deep-Sea Dredgings, addressed to Professor Benjamin Pierce, Superintendent United States Coast Survey,"[1] in which he says:—

> On the point of starting for the Deep-Sea Dredging Expedition, for which you have so fully provided, and which I trust may prove to be one of the best rewards for your devotion to the interests of the Coast Survey, I am desirous to leave in your hands a document which may be very compromising for me, but which I nevertheless am determined to write, in the hope of showing within what limits natural history has advanced toward that point of maturity when science may anticipate the discovery of facts.
>
> If there is, as I believe to be the case, a plan according to which the affinities among animals and the order of their succession in time were determined from the beginning, and if that plan is reflected in the mode of growth, and in the geographical distribution of all living beings; or, in other words, if this world of ours is the work of intelligence, and not merely the product of force and matter, the human mind, as a part of the whole, should so chime with it that, from what is known, it may reach the unknown; and if this be so, the amount of information thus far gathered should, within

[1] "Bulletin Mus. Comp. Zoölogy," Vol. III., Cambridge, 1871.

the limits of errors which the imperfection of our knowledge renders unavoidable, be sufficient to foretell what we are likely to find in the deepest abysses of the sea, from which thus far nothing has been secured.

. . . There is a correlation between the gradation of animals in the complication of their structure, their order of succession in geological times, their mode of development from the egg, and their geographical distribution upon the surface of the globe. If that be so, and if the animal world designed from the beginning has been the motive for the physical changes which our globe has undergone, and if, as I also believe to be the case, these changes have not been the cause of the diversity now observed among organized beings, then we may expect, from the greater depth of the ocean, representatives resembling those types of animals which were prominent in earlier geological periods, or bear a closer resemblance to younger stages of the higher members of the same types, or to the lower forms which take their place nowadays.

As the adversaries of Agassiz not only sharply criticised, but even scouted these views, and cast all manner of fun upon them, and as I made the suggestion to him that successive marine faunas would be found at successive great depths, according to the number of fathoms, showing a correlation between the depth and the geological periods, the deepest possessing forms of the primordial fauna, and consider myself as responsible for it, I would call attention to the following facts, very lately made public.

This prophetic announcement has been at least fully confirmed in regard to *Radiolaria*, which have been brought up from great depths, varying from six thousand to thirteen thousand metres, and present numerous genera absolutely identical with forms existing, not only in the Mesozoic and Palæozoic strata, but even

from the Infra-primordial fauna of the Lower Taconic. The persistence of several genera from the oldest quartzite rocks in North Britanny, near Saint Lô,[1] through millions of years, notwithstanding the metamorphoses of all other animals around them, is a fact which cannot be put aside by transformists and Darwinians. Immutability of several genera, from the beginning of life on our planet until now, is not in favour of natural selection or evolution. Permanence of forms has existed since the first appearance of life on our planet, — a privilege only enjoyed now by *Radiolaria* and perhaps by *Foraminifera*, but which may be extended, as Agassiz thought, to higher animals, such as Trilobites and Ammonites. It seems only a question of time; for we know yet so little of life at great depths in our oceans that some unexpected discovery may be made, and prove a great bar to all the hypotheses constantly resorted to by the theorists of the Darwin school.

If the hopes formed by Agassiz were not fulfilled by the *Hassler* expedition, it was due mainly, first, to the defects in the dredging apparatus; second, to the inadequate estimate of the time required to explore the deepest abysses of the sea. We shall not know for centuries to come all the fauna of the deep sea. The difficulties of finding animals and bringing them from the sea-bottoms, at great depths, are such that centuries will be required before a complete knowledge of

[1] "Les preuves de l'éxistence d'organismes dans le terrain précambrien. Première note sur les Radiolaires précambriens," par L. Cayeux ("Bulletin Soc. Géol. France," 3d Série, Tome XXII., pp. 197–228; Paris, 1894).

the exact distribution of marine animals at the different zones of depth in the oceans can be expected.

The most interesting geological parts of the voyage, especially for Agassiz, were the visits to glaciers in the Strait of Magellan and in Smithe's Channel. There he found, almost at sea-level, great glaciers like the Aar, Aletch, and Rhone glaciers of Switzerland. The marks of *Roches moutonnées*, moraines, scratched pebbles, and boulders were seen, and ancient traces of glacial action found in many places, on the southern extremity of the South American continent, which was a great satisfaction to the old landlord of the "Hôtel des Neuchâtelois" in the Bernese Oberland; and the discoverer of the "Ice epoch" had the pleasure of seeing his prediction in his Discourse at Neuchâtel in 1837 verified, even in the Southern Hemisphere. As he said on his return to Cambridge, "If I had done nothing else but see and study the glacial phenomena at the Magellan Strait and among the Chiloë Islands, this would have amply paid me for all my trouble and fatigue." What does not geology owe to such an observer? To him, and to him alone, is due the discovery of the existence of glaciers in Scotland, England, and Ireland, and their extension over all New England, and in the province of Ceará in Brazil, and in Chili. Seldom does a savant have the opportunity to verify, on the field, in both hemispheres, observations made in the limited area of such a small country as Switzerland. Such a success was only possible to the foresight and genius of an Agassiz.

At Talcahuana Agassiz disembarked, and thence

travelled by post to Curicu and by rail to Santiago. The *Hassler*, after repairs, resumed its cruise to the island of Juan Fernandez, with only Pourtalès and Dr. Hill on board, to continue the dredging and other scientific observations. But the sounding-lines broke down entirely, the ropes rotted, and it became impossible to dredge at a depth even of one hundred fathoms.

It was a great disappointment to Agassiz and Pourtalès, after coming so far, to be deprived of expected results by defective machinery and worthless apparatus. Before leaving Cambridge, Agassiz had written in his Annual Report as director of the Museum for the year 1871 that he was going "to explore the greatest depths of the Atlantic and Pacific oceans, on both sides of the American continent"; and in no case was a really great depth reached by the dredge.

At Santiago Agassiz met two old European friends, both eminent naturalists, — Don Ignacio Domeyko, rector (president) de la Universidad de Chile, and Dr. R. A. Philippi, professor of zoölogy and botany at the same university. Domeyko was a student at the Paris School of Mines, when Agassiz was there in 1832; and both met at Cuvier's house and in the office of Élie de Beaumont. No one has done so much as Domeyko to develop mining in Chili, and no one was held in such high regard and respect all over the Chilian Republic. He received Agassiz with open arms, and he and his daughter Annita did all they could to make his visit agreeable and profitable. Philippi had visited Agassiz at Neuchâtel on his return from a scientific exploration

of Sicily with Friedrich Hoffmann and Arnold Escher von der Linth, and there had been a friendly intercourse between them ever since that time. Philippi went to South America about the time that Agassiz came to North America, and his exploration of the great desert of Atacama and subsequent publications are justly celebrated. The alcalde and municipal body of Santiago called on Agassiz, tendering an invitation to a great dinner party and reception in his honour; but his precarious health and fatigue from the journey prevented him from accepting.

A very agreeable telegram from the Emperor of Brazil awaited Agassiz at Santiago; it announced his election as a "Membre étranger de l'Académie des Sciences de l'Institut de France," an honour seldom conferred, on account of the limited number (eight) allowed in this class of members. Several times before, his name had been on the list presented by the committee for election, but, curiously enough, he was always opposed by the zoölogists, while his just claim to the distinction was strongly supported by the physicists, astronomers, mathematicians, botanists, and medical fellows of the Academy. As he says, in a letter to Dom Pedro Secundo: "The distinction . . . unhappily, is usually a brevet of infirmity, or at least of old age, and in my case it is to a falling house that the diploma is addressed. I regret it the more because I have never felt more disposed for work, and yet never so fatigued by it."

He joined the *Hassler* at Valparaiso, after a few days of rest at Santiago, and continued his voyage.

Some dredgings in shallow waters (for the lines had been too short to allow any other dredging) were successfully made along the coast of Peru, and then the steamer headed for the Galapagos Islands.

Ever since Darwin's exploration of these islands in 1835, Agassiz had had a great desire to see the home of the lizard *Amblyrhinchus*, that remarkable remnant of Secondary or Mesozoic times, and he now had the pleasure of watching its capture in considerable numbers, as Steindachner and Pourtalès hunted it on the rocks and in the shallow waters; while from the deck he drew their attention to a large specimen lying on the sand, half choked by the pocket handkerchief tied round its neck, and which swiftly turned round, as it revived, ready to plunge into the sea. Specimen after specimen was placed in alcohol; for Agassiz, as usual with him in the case of rare animals, was never satisfied. The collections made in the Galapagos were important and very valuable, but Agassiz was too old to obtain the full benefit of such an exploration; if it had been made in the prime of his scientific life, the result would have been different. Sickness tormented him during his stay. However, he was quite well again when the steamer dropped anchor opposite Taboga, in the bay of Panama. As soon as his arrival was known in town, fishermen and pearl traders came on board, the latter to find with surprise that a naturalist of such reputation was not necessarily a great purchaser of pearls. His hands were filled with the most superb specimens collected in the bay, several being very large and perfect; but, to their astonishment and disgust, Agassiz pre-

ferred to purchase the most common fishes brought from the city market.

Here the party separated. Pourtalès crossed the Isthmus and took ship at Colon for Washington, while Agassiz and the other members of the party cruised along the Pacific coast of Central America, Mexico, and the two Californias, entering the Golden Gate of the bay of San Francisco on the 24th of August, 1872, a little less than nine months after leaving the wharf of the Charlestown navy-yard at Boston.

A month was spent at San Francisco, in social activity and enjoyment of the great metropolis of the Pacific states, although Agassiz, who was much in need of repose, declined all invitations of too exciting a nature. Every one showed much kindness to both Agassiz and his wife; in fact, it was impossible for Mrs. Agassiz even to go shopping without being recognized by tradesmen and their clerks. Agassiz was too weary of travelling to undertake any scientific researches round San Francisco, and he did not even visit the gigantic Sequoia trees in Calaveras County.

Early in October Agassiz found himself once more in his museum at Cambridge, and it was a great pleasure to the assistants and to all the friends of the institution to see his genial face again. It seems in place here to complete what has been previously said in regard to his museum.

The first four years of its existence, from 1860 to 1864, were very difficult years. Its success was all that could be reasonably expected, both as to its exhibits, which were tolerably presentable, and as to its sci-

entific arrangement. And as it was, the governors of Massachusetts, — Banks and Andrew, — the members of the Legislature, numbers of savants, American as well as foreign, even princes of royal blood, among whom were the Comte de Paris in 1862, and Prince Napoléon Jérome, and Princess Clotide in 1861, visited the Museum with evident satisfaction and pleasure, during what may justly be called its infancy. With Agassiz as a guide, it would have been impossible not to admire both the director and his collections.

After the secession of the Salem party, as the action of the assistant-pupils, in 1864, may be denominated, a better direction of its affairs was soon visible, owing to the continuous and well-directed efforts of Mr. Alexander Agassiz. During the absence of his father in Brazil, he directed the Museum, and although the force employed was much reduced, it worked better, and proved the administrative capacity which has since distinguished Mr. Agassiz.

Agassiz, with his usual generous and enthusiastic encouragement of original observers and students, allowed almost every one the use of the collections; going so far as to send specimens and books to whoever expressed a desire for them. But such a confidence exceeded proper bounds, and as its inevitable result several valuable specimens, books, and papers were lost.

New accessions to the staff of the Museum were made from time to time. Reference to some of the *attachés* has already been made, and it only remains to complete the list, omitting mention of perhaps a

dozen, either on account of the small amount of scientific work they have done, or because of their short connection with the Museum.

Mr. J. A. Allen began as a student in 1862, and took charge of the mammalia and birds in 1864, publishing valuable memoirs on the buffaloes, the pinnipeds, etc. He remained in the Museum until 1884, when he accepted a position at the American Museum of natural history in New York.

During the autumn of 1867, Agassiz called from Prussia an entomologist of great reputation, Dr. Hermann Hagen, to take charge of the collections of articulates. His services to the Museum were invaluable. Following the plan adopted by Agassiz, Dr. Hagen succeeded in placing the numerous and rich collections entrusted to his care in fine condition.

In 1869, Dr. G. A. Maack, a pupil of the celebrated professor, Albert Oppel, of the University of Munich, came to the Museum as assistant in charge of the collection of fossil vertebrates. Having passed several years at Buenos Ayres as an assistant in the National Museum, directed by the learned naturalist, Dr. Hermann Burmeister, Maack was well prepared for the work assigned to him in the Agassiz Museum. Unhappily he accepted the position of geologist and naturalist of the United States Darien Expedition sent by the government to explore the isthmus of Panama, Darien, and Choco, and he returned with his health so impaired by constant attacks of Panama fever that his mind became affected; and in a moment of despondency he ended his life. Maack was an excellent

observer, a good practical geologist, and well posted in osteology and comparative anatomy, and he sent to the Museum large and valuable collections of mammals, birds, reptiles, fishes, molluscs, and radiates, besides palæontological specimens from Carthagena, the Atrato River, Panama, San Miguel, Cupica Bay, and Napipi River.

Dr. Franz Steindachner, attracted by the magnificent collection of fishes, came to Cambridge from Vienna in May, 1870, to assist Agassiz for two years in their arrangement and determination. Chosen to accompany Agassiz in his voyage on the *Hassler*, he had the rare privilege of seeing the fish fauna from Cape Cod to the Strait of Magellan, the Galapagos, Panama, Acapulco, San Diego, and San Francisco. As he had already examined the fauna of the West Coast of Africa, especially at the Cabo de Verde, he had acquired an unusual knowledge of ichthyology. His work at the Museum was most valuable. Returning to his native country at the end of 1872, he was placed at the head of the zoölogical division of the Imperial Museum of natural history at Vienna, and has since become director-general. Before leaving Cambridge, he said to me: "No naturalist knows fishes like Agassiz; his knowledge in ichthyology is unparalleled on account of his researches on both the living and fossil species!" An opinion which, coming from such a learned ichthyologist, who was also reserved and careful in his judgment, is worth recording.

A conchologist of talent, John G. Anthony, was attached to the Museum, about 1864, to catalogue and

label the shells in the Museum. For years he worked faithfully at the task, and, at his death, several years after that of Agassiz, left the conchological collections in an excellent condition.

Leo Lesquereux, during 1868 and 1869, classified the fossil plants at the Museum. After his arrival in America at the end of 1848, Lesquereux studied fossil plants with great success, and had justly become an authority on this subject on both sides of the Atlantic.

I will mention also Charles Hamelin and Messrs. Walter Faxon, Samuel Gorman, and Walter Fewkes, who were attached to the Museum during the last years of Agassiz's life.

Finally Pourtalès resigned his official connection with the Coast Survey in 1873, and took up his residence in Cambridge to assist Agassiz in the general direction of the Museum. As he was the first of the European friends who joined Agassiz at Boston as far back as 1846, it was most appropriate that he should be the last to help him. At the death of his father in 1870, he had inherited a fortune sufficient to place him in an independent position, and he devoted the remainder of his life entirely to his zoölogical studies. Extremely modest and retiring, timid as a child, always a hard worker, but rather slow in all his motions, persistent in his schemes and undertakings, he possessed just the qualities required in the long and weary process of casting and hauling the dredge in the collection of marine animals at great depths. As a curator of the Agassiz Museum, he devoted the last part of his life to

the progress of the institution. Frank de Pourtalès was a man always true to his word, a rare and most trusty friend. His original work in natural history was confined to the deep-sea corals of the Gulf Stream area in the Caribbean Sea, and the Gulf of Mexico, and on the Florida coast, to crinoids and to halcyonarians. He died in July, 1889, at the age of fifty-seven years, and is buried in Mount Auburn cemetery, not far from the grave of his old teacher and friend.

A few quotations from the last report of Louis Agassiz and from the first of his son and successor will show the condition and standing of the Museum of Comparative Zoölogy during the last year of the life of its founder and at the moment of his death.

I have heard it said repeatedly, that the organization of the Museum was too comprehensive, that it covered a wider range than was useful in the present state of science among us, and that since it must collapse whenever I should be taken away, it was unwise to support it on so large a scale. The past year has proved beyond question that the Museum is now so organized (vitalized, as it were, with the spirit of thought and connected work) that my presence or absence is of little importance. It will keep on its course without any new or repeated stimulus beyond the necessary appropriations for its maintenance. As to the expense, I cannot feel that it is disproportionate, because when I compare it with that of institutions of the same character I see that they spend much more for smaller results. The only question now is, whether a museum of the first order is needed in Massachusetts, or not. If the Legislature will favour us with a visit, I would gladly submit our institution to the most critical examination of its organization. I think I can satisfy any competent visitor, that by her liberal support of the Museum, our state has earned the right to say, that among civilized com-

munities there is not a purely scientific establishment of higher character, or distinguished by more active, unremitting original research in various departments of knowledge. If the same pecuniary support it has had in the last two years can be continued in the coming years, it will not be long before the scientific world will acknowledge that the Museum of Comparative Zoölogy in Cambridge has no superior, nay, no equal, in the world (Report of the Director, in the "Annual Report of the Museum of Comparative Zoölogy at Harvard College, in Cambridge, for 1872," pp. 4, 5; Boston, 1873).

Early in 1873 it became apparent that the Museum could not longer be carried on with the means at the disposal of the Curator. Repeated assistance from the state and from private sources kept the institution up to a standard of activity far beyond its own regular resources. As the time drew near when retrenchment seemed inevitable, Professor Agassiz made an appeal to the Legislature for support, and with the generosity which has always characterized their action towards an institution in which the state of Massachusetts has so great an interest, the Legislature appropriated twenty-five thousand dollars, on condition that a similar sum should be contributed by the friends of the institution towards its support. This sum was at once subscribed by friends of the Museum, and the appropriation of the state secured. Soon after this a further sum of one hundred thousand dollars was presented to the Museum by Mr. Quincy A. Shaw. These sums gave Professor Agassiz the means to reorganize the Museum on a very extensive scale. Additional assistants were employed, collections were purchased in every direction, and a large outlay made to place in safety the valuable alcoholic collections stored in the cellar of the Museum building. True to his policy of always using his present means as a lever for further improvement, nothing was laid up for the future and by the first of April next the Museum will have to depend entirely upon its invested funds for its resources. This will entail a very material reduction in the working force and running expenses, as the regular income of the Museum is somewhat less than

fifteen thousand dollars annually, only half the sum needed to carry on the present scale of operations ("Annual Report of the Museum for 1873," pp. 4, 5; Boston, 1874).

The constant success of Agassiz, in obtaining for his Museum appropriations of large sums of money from the Legislature of Massachusetts, is something unique in natural history, for the Museum has been finally turned over by its trustees to Harvard University, a private corporation; and if Harvard had asked of the Legislature a sum of money, however small, for the foundation of a museum, it would never have been granted. The success is entirely personal, and due wholly to Agassiz's power of persuasion He quickly became expert in handling the Legislature When called before the Committee of Appropriations to explain the nature of his wants, he would meet every member of the committee, first in private, then in the committee-room. But before any step was taken, he would call on the Governor, the Lieutenant-Governor, the President of the Senate, the Speaker of the House, the Secretary of the Board of Education, and the Chief Justice of the Supreme Court, all *ex-officio* trustees of the Museum, and consequently in sympathy with its needs. The amount of scientific diplomacy he made use of is something astounding; for instance, he would detail, with great clearness, the working of the institution, and make it clear that the Museum is an element of education even in the most elementary school of the commonwealth, and that in the future generations there would not be a child who would not have the oppor-

tunity of understanding the scheme of creation as thoroughly as he understood his multiplication table. He had the tact to adapt his explanations and his description of the absolute poverty of the institution, to the listener and his official position in the state. Then, after weeks of such preparatory work at the state house, came the annual visit of the whole Legislative body, with the Governor at its head, to the Museum. Everything was in readiness for the reception when the six or ten street cars, filled with legislators, arrived at the University grounds. Agassiz conducted them at once into the various exhibition halls, showing the treasures of each, and briefly describing the departments. Afterward, in the lecture-room, in an informal conversation, he detailed the methods and needs of the institution. He always succeeded in winning to his side farmers, tradesmen, and politicians. After such a visit, the Legislature always voted a new appropriation of public money; it was only necessary for the President of the Senate and the Speaker of the House to make speeches in its favour, and the resolution would easily pass the three readings without further debate.

Agassiz made stupendous efforts, during the last fourteen years of his life, to obtain seven hundred thousand dollars to found his Museum. Less than half of it was furnished by the state of Massachusetts, and the rest by private subscriptions, a great part of it coming from his own family and relatives. If he had gone to Washington and made only half the exertion he did in Boston, he would have easily obtained from Congress ten and even twenty millions of dollars to found the United

States National Museum. The University of Cambridge cannot be grateful enough for the service he rendered in identifying himself with it, and founding for its benefit an American institution, which, in many respects, rivals the great museums of London, Paris, Vienna, and Berlin.

CHAPTER XXIII.

1873.

THE ANDERSON SCHOOL OF NATURAL HISTORY AT PENIKESE ISLAND — AN UNEXPECTED GIFT — "EVOLUTION AND PERMANENCE OF TYPES" — AGASSIZ'S LAST WORDS ON DARWINISM — THE GIGANTIC SQUID OF NEWFOUNDLAND — AGASSIZ'S LAST ILLNESS — HIS LAST WORDS — DEATH — POST-MORTEM EXAMINATION — THE FUNERAL — THE GRAVESTONE.

AGASSIZ came back from his journey around South America with such renewed vigour of mind and body that he renewed his social duties, and his always hospitable house was often open to his friends and his large family circle.

At the beginning of 1873 occurred the most extraordinary episode in Agassiz's life. A merchant of New York, upon seeing in the newspapers the announcement that Agassiz proposed to give a course of instruction in natural history, chiefly designed for teachers, and students preparing to become teachers, to be delivered on the island of Nantucket during the summer months, offered him Penikese Island, one of the Naushon Islands, in Buzzard's Bay, opposite New Bedford, on the southern coast of Massachusetts, and to complete the gift, an additional endowment of fifty thousand dollars, for the support

and maintenance of the school. To a man of the optimistic and enthusiastic temperament of Agassiz, the offer was too great a temptation to resist, notwithstanding his age and his broken health. Those near him knew that he was not in a condition to accept such a heavy burden, in addition to the many engagements already assumed. But remonstrances were of no avail; he answered all objections, and after a few weeks of hesitation accepted the gift. As his son says: "It is a new *pompe* added to the many already in activity." Mr. Alexander Agassiz, above all a business man, was justly alarmed at the anticipated expenses of the Museum, without the addition of another burden, the extent of which it was impossible to foresee. Knowing his father's propensity to "faire grand" in everything relating to science, without any regard to expenditure, it is not surprising that he was opposed to the acceptance of the gift. But it was impossible to restrain Agassiz when he had started on any special scheme, and a summer school of natural history had been for years one of his pet desires.

In March, 1873, he wrote to Mr. John Anderson: "It seems to me impossible to do otherwise than accept the great gift you offer. It changes at once an experiment without fixed location or stable foundation into a permanent school for the study of nature, such as the world has not seen before. . . . I am overwhelmed by your generosity [the additional endowment of fifty thousand dollars]. Such a gift, following so close upon the donation of an island, admirably adapted by its position for the purposes of a practical school for natural his-

tory, opens visions before me such as I had never dared to indulge in connection with this plan."

On the 22d of April, in company with members of the city government of New Bedford and a number of invited guests, he visited the island to take formal possession, where the party was cordially welcomed by Mr. and Mrs. Anderson. Under these circumstances Agassiz first met Mr. Anderson, and for the first time saw what was to be one of his future laboratories in the cause of natural science. The ceremony of the transfer took place in the house of Mr. Anderson, his solicitor reading the deed of conveyance.

Agassiz returned from his visit, delighted with the island and its surroundings. He at once ordered a building for the laboratory, upon which work was immediately begun, and by the 8th of July the building was ready for the reception of fifty persons, and the school of natural history commenced on the appointed day. The lecture-room was an old barn, and there Agassiz, with bared head, called the pupils to join him in silent prayer. Whittier's poem on this subject is as follows:—

THE PRAYER OF AGASSIZ.

On the isle of Penikese,
Ringed about by sapphire seas,
Fanned by breezes salt and cool,
Stood the Master with his school.
Over sails that not in vain
Wooed the west-wind's steady strain,
Line of coast that low and far
Stretched its undulating bar,
Wings aslant along the rim
Of the waves they stooped to skim,

Rock and isle and glistening bay,
Fell the beautiful white day.
Said the Master to the youth:

"We have come in search of truth,
Trying with uncertain key
Door by door of mystery;
We are reaching, through His laws,
To the garment-hem of Cause,
Him, the endless, unbegun,
The unnamable, the One
Light of all our light the Source,
Life of life, and Force of force.
As with fingers of the blind,
We are groping here to find
What the hieroglyphics mean
Of the Unseen in the seen,
What the Thought which underlies
Nature's masking and disguise,
What it is that hides beneath
Blight and bloom and birth and death.
By past efforts unavailing,
Doubt and error, loss and failing,
Of our weakness made aware,
On the threshold of our task
Let us light and guidance ask,
Let us pause in silent prayer!"

Then the Master in his place
Bowed his head a little space,
And the leaves by soft airs stirred,
Lapse of wave, and cry of bird
Left the solemn hush unbroken
Of that wordless prayer unspoken,
While its wish, on earth unsaid,
Rose to heaven interpreted.

As in life's best hours we hear
By the spirit's finer ear
His low voice within us, thus
The All-Father heareth us;
And His holy ear we pain
With our noisy words and vain.
Not for Him our violence
Storming at the gate of sense,
His the primal language, His
The eternal silence!

Even the careless heart was moved,
And the doubting gave assent,
With a gesture reverent,
To the Master well-beloved.
As thin mists are glorified
By the light they cannot hide,
All who gazed upon him saw,
Through its veil of tender awe,
How his face was still uplit
By the old sweet look of it,
Hopeful, trustful, full of cheer,
And the love that casts out fear.
Who the secret may declare
Of that brief, unuttered prayer?
Did the shade before him come
Of th' inevitable doom,
Of the end of earth so near,
And Eternity's new year?

In the lap of sheltering seas
Rests the isle of Penikese;
But the lord of the domain
Comes not to his own again;
When the eyes that follow fail,
On a vaster sea his sail
Drifts beyond our beck and hail.

Other lips within its bound
Shall the laws of life expound;
Other eyes from rock and shell
Read the world's old riddles well;
But when breezes light and bland
Blow from summer's blossomed land,
When the air is glad with wings,
And the blithe song-sparrow sings,
Many an eye with his still face
Shall the living ones displace,
Many an ear the word shall seek
He alone could fitly speak.
And one name forevermore
Shall be uttered o'er and o'er
By the waves that kiss the shore,
By the curlew's whistle sent
Down the cool, sea-scented air;
In all voices known to her,
Nature owns her worshipper,
Half in triumph, half lament.
Thither Love shall tearful turn,
Friendship pause uncovered there,
And the wisest reverence learn
From the Master's silent prayer.

It was amusing to see Agassiz delivering his lectures, surrounded not only by forty-four students,[1] of both sexes, but by the workmen who were finishing the interior arrangements and erecting a second building. Never had the small island seen so many people collected on its shores. Every one was collecting, examining with microscopes, dissecting, or watching marine animals in

[1] Among the students at Penikese, I will mention only a few who have become celebrated since: Professor C. O. Whitman of Chicago University, D. S. Jordan, President of the Leland Stanford Jr. University (California), Professor William K. Brooks, and Professor Charles S. Minot.

aquaria improvised out of pails and buckets. Agassiz lectured nearly every day, and frequently twice a day, and his passion for teaching had full play. Mr. C. W. Galloupe of Boston made him a donation of his yacht, *Sprite*, and as she was fully equipped, Pourtalès took charge of her and at once began dredging, going out daily, weather permitting, with eight or ten students, and obtaining a variety of specimens which could not be procured from the shore; and at the close of the school session they went as far as Casco Bay, to dredge for brachiopods and echinoderms that could not be procured in Buzzard's Bay.

Agassiz left Penikese[1] at the end of the summer, when the school broke up, and on invitation of friends visited the mountains for rest, which was an absolute necessity in his present condition of mental and physi-

[1] The Anderson School of Natural History at Penikese Island did not survive long after Agassiz's death. The appeal for aid addressed by Mr. Alexander Agassiz to the superintendents of public institutions and presidents of State Boards of Education of the several states, did not find the ready response necessary for the support of the school, and although the expenses were estimated at a minimum, they were too large for the means at the disposal of the director, and the Anderson School was soon a thing of the past. But if its existence was ephemeral, it set a most beneficial example, soon followed by permanent schools of the same sort, created in imitation of the Marine Biological Laboratory of Penikese Island, first, those at Wood's Holl, Mass., one under the direction of the United States Fish Commission, and the other directed by Mr. C. O. Whitman; second, one at Annisquam, and afterward at several other places on the Atlantic and Pacific coasts, under the direction of the Johns Hopkins University, the State University of California, and the Leland Stanford Jr. University, while Mr. Alexander Agassiz, notwithstanding his failure at Penikese in carrying on the school, has since built a fine laboratory at Castle Hill, near his summer residence at Newport, Rhode Island, where researches on living marine animals are made every summer under his direction and at his expense.

cal fatigue. The effort had been too great, and the strain upon his health beyond reason. When among pupils it was impossible to restrain him. He must teach. Teaching was as natural to him as breathing to others; but after his illness of 1870, he was obliged to exert himself to deliver his lectures, and it was often painful to see him forcing his voice through his over-fatigued throat. His throat was the weak point in his herculean frame. However, October, 1873, found him again at his post in his Museum, and he began a course of lectures on the radiates from their first appearance until the present time. At the same time he dictated to Mrs. Agassiz an article for the "Atlantic Monthly," on "Evolution and Permanence of Type," which did not appear until January, 1874, after his death. As it is his last production, it may be taken as "Louis Agassiz's Scientific Will"; and a few quotations will serve to show his strong convictions on the most exciting of all natural history subjects.

The law of evolution, so far as its working is understood, is a law controlling development and keeping types within appointed cycles of growth, which revolve forever upon themselves, returning at appointed intervals to the same starting-point, and repeating through a succession of phases the same course. These cycles have never been known to oscillate or to pass into each other; indeed, the only structural differences known between individuals of the same stock are monstrosities or peculiarities pertaining to sex, and the latter are as abiding and permanent as the type itself. Taken together the relations of sex constitute one of the most obscure and wonderful features of the whole organic world, all the more impressive for its universality. . . .

Under the recent and novel application of the terms "evolution" and "evolutionists," we are in danger of forgetting the only process

of the kind in the growth of animals which has actually been demonstrated, as well as the men to whom we owe that demonstration. Indeed, the science of zoölogy, including everything pertaining to the past and present life and history of animals, has furnished, since the beginning of the nineteenth century, an amount of startling and exciting information in which men have lost sight of the old landmarks. In the present ferment of theories respecting the relations of animals to one another, their origin, growth, and diversity, those broader principles of our science — upon which the whole animal kingdom has been divided into a few grand comprehensive types, each one a structural unit in itself — are completely overlooked. . . .

The time has, perhaps, not come for an impartial appreciation of the views of Darwin, and the task is the more difficult because it involves an equally impartial review of the modifications his theory has undergone at the hands of his followers. The aim of his first work on "The Origin of Species" was to show that neither vegetation nor animal forms are so distinct from one another or so independent in their origin and structural relations as most naturalists believed. This idea was not new. Under different aspects it has been urged repeatedly for more than a century by de Maillet, by Lamarck, by E. Geoffroy Saint-Hilaire and others; nor was it wholly original even with them, for the study of the relations of animals and plants has at all times been one of the principal aims of all the more advanced students of natural history; they have differed only in their methods and appreciations. But Darwin has placed the subject on a different basis from that of all his predecessors, and has brought to the discussion a vast amount of well-arranged information, a convincing cogency of argument, and a captivating charm of presentation. His doctrine appealed the more powerfully to the scientific world because he maintained it at first not upon metaphysical ground, but upon observation. Indeed, it might be said that he treated his subject according to the best scientific methods, had he not frequently overstepped the boundaries of actual knowledge and allowed his imagination to supply the links which science does not furnish. . . .

The excitement produced by the publication of "The Origin of Species" may be fairly compared to that which followed the appearance of

Oken's "Natur-Philosophie," over fifty years ago, in which he claimed that the key had been found to the whole system of organic life. . . .

Darwin's watchwords, "natural selection," "struggle for existence," "survival of the fittest," are equally familiar to those who do, and to those who do not, understand them; as well known, indeed, to the amateur in science as to the professional naturalist. His theory is supported by a startling array of facts respecting the changes animals undergo under domestication. . . .

The final conclusion of the author is summed up in his theory of Pangenesis. And yet this book does but prove more conclusively what was already known; namely, that all domesticated animals and cultivated plants are traceable to distinct species, and that the domesticated pigeons, which furnish so large a portion of the illustrations, are, notwithstanding their great diversity under special treatment, no exception to this rule. The truth is, our domesticated animals, with all their breeds and varieties, have never been traced back to anything but their own species, nor have artificial varieties, so far as we know, failed to revert to the wild stock when left to themselves. Darwin's works and those of his followers have added nothing new to our previous knowledge concerning the origin of man and his associates in domestic life, the horse, the cow, the sheep, the dog, or, indeed, of any animal. The facts upon which Darwin, Wallace, Haeckel, and others base their views are in the possession of every well-educated naturalist. It is only a question of interpretation, not of discovery of new and unlooked-for information. . . .

It has even been said that I have myself furnished the strongest evidence of the transmutation theory. This might, perhaps, be so, did these types follow, instead of preceding, the lower fishes. But the whole history of geological succession shows us that the lowest in structure is by no means necessarily the earliest in time, either in the vertebrate type or any other. Synthetic and prophetic types have accompanied the introduction of all the primary divisions of the animal kingdom. With these may be found what I have called embryonic types, which never rise, even in their adult state, above those conditions which in higher structures are but the prelude to the adult state. It may, therefore, truly be said that a great variety of types has existed from the beginning. . . .

The world has arisen in some way or other. How it originated is the great question, and Darwin's theory, like all other attempts to explain the origin of life, is thus far merely conjectural. I believe he has not even made the best conjecture possible in the present state of our knowledge. . . .

I would add as a *résumé:* Man has not yet been able to create, or "evolve," if the word is more acceptable to the followers of Darwin's theory, a single true species of animal or plant; but *per contra* he has certainly the power to destroy them, several species of animals having been exterminated during the last two centuries by men — not one of whom knew anything about the origin of species, according to Darwin, Lamarck, Haeckel, or Huxley. Destruction is certainly easier than evolution.

The last, but not the least, natural history surprise enjoyed by Agassiz came from Newfoundland. Fishermen in Conception Bay, in a battle against a gigantic squid, succeeded in cutting off and securing an arm of the beast nineteen feet long. The body of the animal was sixty feet long, and his diameter not less than five feet. The state geologist of Newfoundland, Mr. A. Murray, wrote me a long letter[1] on this remarkable monster, which I hastened to communicate to Agassiz. The following is Agassiz's letter to Mr. Murray on the subject: —

CAMBRIDGE, MASS., Nov. 25, 1873.

My dear Sir, — My friend Marcou has communicated to me your most interesting letter; and I am delighted at last to have so direct information concerning the gigantic cephalopods of the Atlantic, of which so much has been said since the days of Pontoppidan in his

[1] This letter from Mr. Murray was published in "The American Naturalist," Vol. VIII., pp. 120–123. February, 1874. Salem.

"Norwegian Fables of the Kraken." I will now hunt up everything that is worth noticing upon the subject; and if you will allow me an examination of your specimen, the zoölogical characters of the creature might be made out from the part preserved, as we do of imperfect fossil remains. I would also ask leave to publish the substance of your letter to Mr. Marcou, in connection with this.

With great regard, yours very truly,

LS. AGASSIZ.

ALEX. MURRAY, ESQ.,
ST. JOHN'S, NEWFOUNDLAND.

This letter and the two following, of which a facsimile is here given, were the last scientific letters written by their illustrious and lamented author, the last one on the 26th of November, 1873.

Museum of Comparative Zoology,

CAMBRIDGE, MASS. Nov. 26.
1873

Mon cher Marcou,

Merci pour la lettre et la photographie que Mr. Murray vous a adressées. C'est fort curieux et avec votre permission j'en publierai le contenu accompagné de remarques, si Mr. M. veut m'envoyer une des grandes rentoures pour la comparer à celles des espèces de Céphalopodes connues sur nos côtes. Je vais lui écrire aujourd'hui à ce but.

Tout à vous

L. Agassiz

Museum of Comparative Zoology,

CAMBRIDGE, MASS.

Mon cher Marcou,

J'ai fait copier la lettre de Mr. Murray et je vous retourne l'original. Plus je considère cette trouvaille et plus elle m'intéresse. C'est vraiment important pour l'histoire des Céphalopodes.

Bien à vous

L. Agassiz

(Post-marked Nov. 26, 1873.)

On the 2d of December Agassiz delivered his last lecture before the Massachusetts Board of Agriculture at Fitchburg, on "The Structural Growth of Domesticated Animals." On the 5th he enjoyed, as usual, his weekly family dinner, with all his children around him, smoked cigars, contrary to the special order of Dr. Brown-Séquard; but the next morning, the 6th, he complained of a dimness of sight, of feeling "strangely asleep," and of great weariness. He went, nevertheless, to his Museum, but soon returned, and lay down in his room. It was his last illness. Paralysis of

the larynx rapidly developed; and all the care and skill of Dr. Brown-Séquard, then in New York, who came at once to the side of his friend, and of another friend, Dr. Morrill Wyman, could not stay the mortal disease.

Agassiz had been in great dread of softening of the brain, of which his friend, Professor Bache, had died in 1866, after a very long and most painful illness. He often expressed the hope that he should disappear suddenly; and his wish was in great part realized, for he lingered only eight days. It was, however, hard for him to die just when fortune had at last smiled on him and all his children; and when everything was ready for the realization of the two dreams of his life, — a great museum and a practical school of zoölogy; but the old Arab proverb proved true also for him: "When the house is ready, death walks in."

He had so many schemes, and was so full of projects, that desire to prolong life was still very strong in him, even after he was stricken by such a grave illness. The presence at his bedside of the great physiologist, Dr. Brown-Séquard, encouraged him, and it was not until the last day that he gave up all hope. During his short illness, which was undisturbed by acute suffering, he received every comfort which his family could divine.

Agassiz resumed his native language as soon as Dr. Brown-Séquard came, and used it until the end. When all hope of recovery was given up, during the last eighteen hours, he often said, "Tout est fini!" And when the last moments came, all retired to the adjoining room to let him finish his life in complete quietness;

Grave of Louis Agassiz at Mount Auburn (Front).

while they kept watch over him from the open door, relieving one another from time to time. It was Pourtalès who, at the last moment, was surprised to see him rise in his bed, and to hear him exclaim, with great distinctness, "Le jeu est fini!"[1] Then he fell back, and died, shortly after ten o'clock P.M., the 14th of December, 1873. Life for him had been a long and successful play, well filled from beginning to end. A post-mortem examination was made by Drs. Brown-Séquard, Jeffries and Morrill Wyman, assisted by five other physicians. The brain was found to be very large and heavy, like that of George Cuvier, and traces of disease were recorded for a period dating back at least twelve years.

The funeral took place on the 18th, at 2 P.M., in Appleton Chapel, in the College ground, Harvard Square. Rev. Dr. Andrew P. Peabody, professor in the College, conducted the service, according to the King's Chapel liturgy, of Boston. It was simple, all ceremonies except the strictly religious rites being dispensed with. The church was crowded with the most noted assembly ever seen in New England, including the Vice-President of the United States, the Governor, Ex-Governor, admirals, major-generals, poets, naturalists, savants, and distinguished ladies, together with the little band of Europeans who came with Agassiz to the New World, and all the members of the faculty of the University, with the students in a body.

It was a winter afternoon, without snow, and not a

[1] This recalls the exclamation of Rabelais at the moment of his death, "La farce est jouée."

cold day. When the benediction was pronounced, the body was removed, the organ playing the "Dead March in Saul." A long procession followed to Mount Auburn, where the remains were buried in one of the most beautiful parts of the cemetery, very near the grave of Agassiz's friend, Felton. The monument erected over his grave is symbolic of one of his most remarkable discoveries. It is simply an Alpine boulder, weighing twenty-five hundred pounds, from the moraine of the glacier of the Aar. This granite block was selected by his cousin, M. Auguste Mayor, of Neuchâtel, from the lateral moraine, not far from the spot where the celebrated "Hôtel des Neuchâtelois" once stood. It was carried with great difficulty, "à force de bras," from the glacier to the Bernese Oberland village of Imhof, a distance of twenty-five miles, thence on a wagon to the railroad station of Thun. Around this superb boulder — on which are engraved on one side the words, "Jean Louis Rodolphe Agassiz," and on the other, "Born at Motier, Switzerland, May 26, 1807; died at Cambridge, Mass., December 14, 1873" — there are several pine trees which formerly grew near the celebrated boulder called "Pierre-à-Bot," above the city of Neuchâtel, and which were successfully transplanted, and now shelter the Agassiz lot.

Grave of Louis Agassiz at Mount Auburn (Back).

CHAPTER XXIV.

Physical and Moral Characteristics — His Generosity — Opinions of Mrs. Elizabeth Agassiz and Professor Karl Vogt — Parallel between Agassiz and Cuvier.

Dr. Professor Hermann Lebert, the anatomist and naturalist, says: "Agassiz was one of the most brilliant men of his time. Young, handsome, of an athletic constitution, gifted with a captivating eloquence, his spirit was animated by an insatiable curiosity, his memory excellent, his perspicacity rare and very keen, and his way of judging and coördinating facts highly philosophical in its tendency" ("Actes de la Société helvétique des sciences naturelles réunies à Bex," août, 1877, p. 149). No one was better fitted to give an exact description of the physical and scientific characteristics of Agassiz than Dr. Lebert, who had known him well during the twelve years of his greatest scientific activity, from 1834 to 1846.

Agassiz was a little above the average height, although not tall. He was squarely built, with broad shoulders and a powerful and well-proportioned body, and with remarkably large, and at the same time well-formed, hands, which he always used most skilfully. They were the hands of an artist or of a naturalist, ready to use the pencil, the hammer, the scalpel, or

the microscope, and his manner of shaking hands was very cordial and friendly. He stood firmly, though his feet were rather small in comparison with his herculean structure, and seemed formed for walking; indeed, he was all his life a capital pedestrian, both on level ground and among the Alpine mountains.

His head was simply magnificent, his forehead large and well developed; and his brilliant, intelligent, and searching eyes can be best described by the word fascinating, while his mouth and somewhat voluptuous lips were expressive, and in perfect harmony with an aquiline nose and well-shaped chin. His hair was chestnut colour and rather thin, especially on the top of his head; indeed, after he was thirty-six years old he showed signs of baldness, which greatly increased after his fiftieth year. The only part of Agassiz's body which was not in harmony with the rest was his short neck, which gave him the appearance of carrying his head on his shoulders, — a defect which he possessed in common with Napoleon Bonaparte. It was his weak point, and the part which failed first.

He was easily moved to tears, and at times cried like a child. He had spells of laughing, which sometimes seemed forced, but which were perfectly spontaneous. It was almost impossible for him to conceal his emotions. This remark applies more especially to the first forty years of his life; later, he was less apt to show his feelings. During the first half of his life he was seldom angry, however great the provocation might be. But after 1853, he quite often got into a passion, even losing control of his words, although he

never ceased to be a gentleman, and was careful not to wound too deeply his adversaries or the person with whom he was discussing. As one of his most constant and bitter enemies said, he was "un bon enfant." During his youth and student life, and even as late as his "séjours" at the "Hôtel des Neuchâtelois," he used to sing, and even to yodel, like the Tyrolese peasants and the Oberland guides; but he completely ceased as soon as he landed on American soil.

Fine clothes never attracted him. He was, on the contrary, rather inclined to wear the most common and unbecoming suits and a slouch hat during winter and summer, and I do not believe that during his whole stay in America he ever wore a silk hat. At Neuchâtel, his dress was most ordinary, notwithstanding the rather formal society in which he moved. But in Paris, during his long visit of 1846, he was obliged to follow the customs of other savants, conformed to ever since the time of Cuvier and Humboldt, viz. a black frock coat, white cravat, and high hat. Alexander von Humboldt affected to wear such ceremonial dress even when he explored the Ural Mountains and Central Asia, and Leopold von Buch, as well as Élie de Beaumont, did the same during their geological excursions. It was not becoming to Agassiz, however, and he was delighted when he arrived in America to find that every one dressed as he pleased, without any ceremony or convention of any sort. He very seldom wore gloves, never carried a cane, except an alpenstock, and very seldom used an umbrella. When in Neuchâtel at official

meetings, he wore over his coat the ribbon and cross of the Red Eagle of Prussia, but after leaving Neuchâtel he wore no decorative ribbon of any kind, notwithstanding that he possessed that of knight and officer of the Legion of Honour of France, besides the Prussian order. On the whole, Agassiz was extremely simple, and did not like to make an appearance different from that of ordinary people in his neighbourhood.

Being a good pedestrian, he carried on his back in all his excursions in Switzerland and Southern Germany a knapsack of the kind now called "sacs de tourists." At Neuchâtel one was always lying in the library at the foot of his desk, with hammers and papers and specimens. He did not bring one with him to America, using a carpet-bag instead.

In religion, Agassiz was very liberal and tolerant, and respected the views and convictions of every one. He was opposed to all form and exaggeration, and did not like theology, but avoided, as far as possible, all discussion of the subject. He was neither a sceptic nor a scoffer, and Dr. Karl Vogt, with his unceasing sceptical and cynical attacks against the Bible, shocked him so much that, notwithstanding Vogt's great talents as a naturalist, Agassiz was glad when he left Neuchâtel.

In his youth and early manhood, Agassiz was undoubtedly a materialist, or, more exactly, a sceptic; but in time, and little by little, his studies led him to a belief in a divine Creative Power. He was more in sympathy with Unitarianism than any other Christian denomination. He was married to his second wife

by a Unitarian minister, and his funeral service was conducted by another, both named Peabody, but not related. Agassiz always avoided the society of ministers and clergymen in general, because, as he said, "he saw too many of them in his youth."

In society, he was fond of meeting rich and influential men, being always desirous of acquaintance with those possessing a great name and in high social or official positions. He was an aristocrat by nature, with a strong mixture of popular and democratic habits and manners, and always ready to distribute large doses of "l'eau bénite des cours," in which connection he had been at a good school, with Alexander von Humboldt, who was a perfect courtier.

He was not fond of the society of other savants, often having occasion to complain of their conceit and curiosity. He did not know how to repulse the too familiar manners, and even insolence, to which celebrated men are often exposed. Poets, litterati, historians, philologists, lawyers, and especially merchant princes, were more to his taste. Military officers had no attraction for him; but he was very fond of naval officers and captains of merchant steamship lines.

Agassiz, who was a brilliant conversationist, had also the most winning manners; and he easily induced those around him to accept and even to share in his enthusiasm. If any one resisted, he was not discouraged, and displayed a true coquetry in his efforts to conquer. Easily approached, he met you most openly, with expressions of frankness, mingled with agreeable surprises, and brought you to his view or side almost before you

were aware of it. However, Agassiz seldom revealed himself entirely, and after his fiftieth year he never did so. He possessed the shrewd simplicity characteristic of the Vaudois peasant, and went willingly beyond the mark in order to discover the true meaning of your thought. At first his design did not appear; and you were led to look upon him as a man who said all and even more than he knew and thought. But soon you were obliged to admit that your first impression of the man was erroneous; you found an unconquerable opposition to anything of which he disapproved. Agassiz was very ready to make promises; he asked favours in every direction, and then he was apt to forget the conditions under which they were granted. He was at the same time a dreamer and a man of action, dreaming aloud, and taking the public as a confidant of everything which came into his mind. He was not to be taken at his own word, but it was necessary to allow a large margin for contingencies and changes. When surrounded by material difficulties, he fortified his spirit by a marvellous power of always hoping for better times, having an absolutely unshaken confidence in himself.

He was one of those whose hands and heart are always open; for whom work is the main path of life, and, at the same time, a great pleasure and not to be interfered with, — a sort of prodigal child. "Il ne vivait que pour les autres, s'il n'y avait eu personne pour le regarder tout le temps, il n'aurait pas existé," — a sentence of a distinguished French author, which applies fully to Agassiz. He always thought that he

had not enough friends or assistants around him. His home was a sort of "phalanstery" of savants. He was always inclined to trust too much to his persuasiveness; and if it often helped him, sometimes it acted otherwise, and was the cause of very regrettable mistakes. He would take for genuine any compliments which flattered some hobby or weak point, and no other explanation can be given of some of his blunders. He repeatedly let escape him — at least in America — several very able savants, retaining instead persons whom he very well knew were not so capable.

I have already had occasion to notice his generosity. Agassiz was a kind-hearted man; he helped many with money, and always in an unostentatious way. It is true that he was often deeply in debt; but as soon as he had money he distributed it almost lavishly, without thinking of the morrow. One anecdote will show how full of liberality and charity he was. A Neuchâtel merchant, established at New York, had suffered pecuniary misfortunes, and become a pauper, perhaps on account of his bad habits. This man had absolutely no claim on Agassiz, who came to Neuchâtel several years after he had left there; but he had kindly received the artist, Burkhardt, at New York, in 1844, and this was reason enough for Agassiz, who ordered the agent of his cousin, M. Auguste Mayor, to pay fortnightly to this poor Neuchâtelois an allowance sufficient for his support until he died, several years after. This occurred during and at the end of the Civil War, before any of Agassiz's children became wealthy.

Mrs. Agassiz says: "The ability, so eminently possessed by Agassiz, of dealing with a number of subjects at once, was due to no superficial versatility. To him his work had but one meaning. It was never disconnected in his thought, and therefore he turned from his glaciers to his fossils, and from the fossils to the living world, with the feeling that he was always dealing with kindred problems, bound together by the same laws."[1] And she adds that Agassiz followed all his life a unity of plan in his scientific researches.

Professor Karl Vogt,[2] of Geneva, who was associated with Agassiz for five years of the most active and scientifically productive part of his life, says: "I never met with another man gifted with such remarkable talent in the zoölogical domain. Agassiz, better than anybody else, made discoveries in collecting materials and looking rapidly over collections; but after a first hasty examination and classification, and when it was time to study methodically the specimens, then he escaped and shut himself up like the folding of the blades of a pocket-knife, and it was most difficult to bring him back to the work only sketched out. . . . He was wanting in character, being like a piece of wax, which retains the mark of the last hand that has held it, and like a weathercock, which turns all around

[1] "Louis Agassiz," by Mrs. E. C. Agassiz, Vol. I., p. 336.

[2] Karl, or Carl, or Charles Vogt, born at Giessen, the 5th July, 1817, died at Geneva, the 5th May, 1895. He was the last surviving member of the scientific household of Agassiz at Neuchâtel. Dr. Charles Frédéric Girard, another assistant, preceded him by only a few months, having died on the 29th of January, 1895, at Levallois-Perret, a suburb of Paris, at the age of seventy-two.

the horizon, believing that it has remained motionless, pointing all the time in the same direction."[1]

These two diametrically opposed views are both exaggerated. The truth lies between them. Agassiz was capricious in the extreme, very versatile, attracted easily by any new object or subject; and he had the faculty of almost completely forgetting works half done or only sketched. He lacked persistence and steadiness at work requiring long and difficult observations. Like a splendid butterfly, he flew from one delight to another. But to compare Agassiz to a weathercock or a piece of wax is a great mistake. When his opinion was formed on a subject, it was impossible to move him. He would listen to all the objections, assent more or less to what was said, but in the end do only what he wanted to do. That something sternly practical mingled with Agassiz's habitual idealism was well proved by his Museum. He did not carry it out entirely, as he proposed to do at the start; but had he lived twenty years longer, his ideal Museum would have become a reality.

He began and abandoned successively many subjects. For instance, after the publication of his "Poissons fossiles" and the "Poissons du vieux grès rouges ou système Dévonien" — that is to say, after 1844 — he never took up the subject again, with the single exception of the study of a few fossil teeth, collected in California, and described in Vol. V. of the "Pacific Railroad Explorations"; (Washington, 1856). He never returned to the glacier of the Aar after his hurried visit in 1845. Fossiles echinoderms were also

[1] "Eduard Desor, Lebensbild eines Naturforschers," p. 18.

a favourite study with him from 1833 to 1846, when he wholly abandoned them. The same is true of the *Mya* and *Trigonia*. He announced ten volumes of his "Contributions to the Natural History of the United States," and only four were published; and, but for his son, his researches on the Florida corals would never have been issued. Part II. of his "Principles of Zoölogy" was never published.

Notwithstanding these serious defects, it is impossible not to admire his great scientific intelligence, and not to recognize his immense scientific force. No one was such an able instigator of scientific researches. He had a magnetic power, and he used it constantly, whatever the subject to be investigated might be. His two principal passions in natural history were teaching and collecting specimens. As a teacher he was unrivalled and unique; and from the first, as a student at Zürich until the last ten days of his life, we may say that he taught. He was always ready to deliver a lecture, — on the glacier of the Aar, at the Little Academy at Munich, at Neuchâtel, at Boston, at Rio Janeiro, at Lake Superior, at sea, on the Amazons, at Cambridge, at Penikese Island, anywhere. He would withdraw for half an hour at most, sometimes for only ten minutes, and then would begin on the subject chosen, speaking with an abundance of detail, broad general views, and philosophical conclusions.

As to his other passion, that of collecting specimens and organizing museums, he was a man of wonderful resource. He was insatiable, and had a real mania for possessing and keeping everything; and he never rejected any specimen or drawing.

An anecdote will show how persistent and skilful he was, when he wanted a rare and valuable specimen. Among the few specimens I had kept from my numerous geological explorations was the head of a mammifer of the Miocene from Nebraska, showing the brain, with even a little reddish colour of the animal's blood on it. Agassiz tried two or three times to get it for his Museum. I resisted, wishing to keep it as a memento of my excursion in Nebraska in 1863. When on the point of leaving Cambridge for a long sojourn in Europe in 1864, Agassiz gave a large dinner party in my honour; and as soon as we were all seated at table, in a loud voice, with an imploring tone and in the most friendly way, he begged for that specimen so hard that it would have seemed cruel to deny his request. In fact, that day he acted like a spoiled child who wanted a long-desired toy. Of course he got it.

Agassiz's first plan was to work at living and fossil fishes, — an immense domain for a naturalist. He added to it the fossil echinoderms and afterward the living echinoderms. All the rest of his work came accidentally or incidentally, but not as a result of a unity of plan. He studied glaciers as a pastime, and to prove that the theory of de Charpentier and Venetz was wrong. His researches on the *Mya* and *Trigonia* were prompted by Gressly's discoveries of fine and rare specimens of these two families of molluscs. As soon as he arrived in America, he turned to turtles and jelly-fishes, and began to work on them with the help, first of Charles Girard and Desor, afterward of Mills and Clark. Agassiz was too easily drawn from one study to another.

He was absolutely devoid of the business faculty, — a defect which would have been of little consequence, if he had not always engaged in undertakings involving great expense and requiring financial capacity of no small order.

Like his master, George Cuvier, Louis Agassiz's personality has strongly marked the natural history of the middle of the nineteenth century. With certain similarities, they present a great many more contrasts, due mainly to the differences in the time of their existence, and also to their peculiar temperaments. Both born at the foot of the Jura Mountains, one at the north, at Montbéliard (Doubs), the other at the east, at Motier (Fribourg), they were descended from families essentially Jurassic, Protestant, and including Protestant ministers. Cuvier came originally from the small village of Cuvier, near Censeau, in the department of Jura, while Agassiz came from the small town of Orbe and the village of Bavois in the Jura Vaudois, at a distance of only twenty-five miles from Cuvier. Their youth was passed in countries using the German language; Cuvier's at Stuttgart, and Agassiz's at Bienne, Zurich, Heidelberg, and Munich. On both, German education left indelible marks, more especially during the first half of their scientific life.

Cuvier was, above all, a careful observer of facts. In all zoölogical questions he was never led by his imagination; the only field in which he followed preconceived theory was in general geology, in what he has called the "Révolutions du Globe." On the contrary, Agassiz was inclined to theorize; his brilliant imagina-

tion was constantly alert and given to prophesying the future of science. However, having seen much more of the world than Cuvier ever did, his large practical experience often put a limit to his audacious generalizations, bringing him to more just and rational ideas, more especially in regard to physical geography.

Cuvier was an excellent practical geologist and observer in the field, and he understood, and may be said to have created, all the principles of stratigraphy and of classification of strata. However, he failed completely in trying to maintain the question of the universal deluge, and the biblical genesis, notwithstanding many contradictory facts well known to him, and which he systematically ignored; as witness his celebrated command to his assistant, Laurillard, to throw out of his laboratory window the skeleton of the fossil man of Lahr (Grand Duchy of Baden), found in the loess (Quaternary) by Ami Boué, saying: "cela vient d'un cimetière." Cuvier thought that no human bones could be fossil remains, an opinion often disproved by facts since 1829. Boué, justly wounded by this rash exclamation of Cuvier, calls it his "hypocrisie biblique," — a phrase which he extends even to Agassiz in his "Autobiographie," 1879, p. xix. of the catalogue of his works. Cuvier and Agassiz were unwilling to mix science and religion, and from their education and their connection with Protestantism, did not feel justified in accepting facts which seemed probable only, but which lacked substantial and repeated proofs. Neither of them was hypocritical, having too great a respect for science to merit such a grave condemnation. Boué went too

far in his criticism,[1] although his discovery of a fossil Quaternary man is a fact now fully accepted.

Agassiz was not a good practical geologist, like Cuvier. His active spirit did not allow him to follow patiently the always long, tedious, and often too-fatiguing researches of practical geology. He wanted the results which he could promptly obtain in the drawers, on the shelves, and in the glass cases of large collections. There Agassiz had not his equal, being even quicker than Cuvier.

Both spoke slowly and with that drawling accent peculiar to the Jurassic peoples, and at their first meeting they recognized one another as children of the Jura. Agassiz kept the accent almost to his sixtieth year; as for Cuvier, he kept it until the end of his life, in consequence of his daily intercourse with his countrymen from Montbéliard, his brother Frédéric, his assistant, Laurillard, and his pupil and cousin, the naturalist Duvernoy.

Cuvier was very grave, while Agassiz, on the contrary, was always laughing, or, at least, smiling. Cuvier had a special aptitude for all kinds of knowledge, and possessed talents to fill any official position, such as professor, general inspector of public instruction, state councillor, great chancellor of the University, or secre-

[1] Here is the quotation regarding Agassiz: "Parmi les savants de renom Cuvier n'est pas du reste le seul, qui ait préféré l'hypocrisie à la vérité, l'exemple le plus connu est celui d'Agassiz, qui pour s'assurer sa position en Massachusetts et y pouvoir établir un superbe musée zoologique à Cambridge passa sous les fourches caudines du protestantisme méthodiste le plus absurde." This is a remarkable example of misrepresentation and misunderstanding of the true position of Agassiz in Massachusetts.

tary of public instruction, peer of France, perpetual secretary of the Academy of Science, etc., etc., while Agassiz limited himself all his life entirely and exclusively to natural history. Both possessed an extraordinary memory, and both were remarkably gifted with the faculty of order; both were capable of long labour, and at the same time both worked with great facility. With them work was always easy. They did it without effort; it was natural to them. But neither was inventive; both saw facts and observed them sharply, but neither thought to link them by theories calculated to conduct to the discovery of other facts. They were "terre à terre" naturalists, while Lamarck, Geoffroy Saint-Hilaire, Darwin, Huxley, looked forward to the future, prophesying, and always ready to call to their help suppositions and probabilities.

Physically, Cuvier and Agassiz resembled each other in possessing enormous heads and largely developed brains, while neither Lamarck nor Darwin were abnormal as regards size and development of the head. In a crowd Cuvier and Agassiz always attracted attention, and were distinguished at once as uncommonly fine-looking men, while Lamarck, Darwin, and Huxley passed unnoticed.

Agassiz did not possess the original ideas, or the great sagacity, or the depth of view of Cuvier. He did not open new roads to natural history, but he enlarged greatly all those which were pointed out by others. If Cuvier had an enormous influence on the future of science and on the savants themselves, Agassiz had more influence on the masses; he made science more

popular, gave a strong impulse to the development of questions very little known before him, and created a more elementary method of teaching. Agassiz delighted in making pupils, and was always on the lookout for applause from all his hearers, whoever they might be, savants or populace. Cuvier, on the contrary, never took the trouble to make pupils, although he left several after him, among them Agassiz and Richard Owen; he never courted applause nor popularity. Cuvier took care to screen himself, and preferred the solitude of his laboratory and library, while for Agassiz solitude was insupportable; he wanted to be surrounded at all times by pupils or admirers. He courted bustle. This is a very unusual characteristic among savants, who are generally more or less retiring, and conduct their researches in the solitude of a laboratory, far from all distractions. As soon as Agassiz had found something new, he proclaimed it even before he had obtained all the proofs. He was always anxious to make an impression on his surroundings and his contemporaries. He was a leader of men, and above all a charmer. Cuvier, on the contrary, was difficult to reach, always on his guard, and very reserved. He did not care about publicity, but he was extremely desirous to make discoveries and keep them secret, until he had deduced all the consequences, and proved them beyond question.

If Cuvier showed great superiority and inventive genius in his classification of the animal kingdom, in his comparative anatomy, his restoration of the forms of fossil vertebrates, his description of the geology of

Paris basin in collaboration with Alexander Brongniart, and in his celebrated lectures at the Jardin des Plantes, and at the College de France, Agassiz rose very high in his study of the "Poissons fossiles," the living fishes, the echinoderms, the *Myae*, the embryology of the turtle, the Acalephs, in the description of the glacial epoch in collaboration with Venetz and de Charpentier, and in his popularization of natural history in North and South America, and finally in his creation of a great museum at Cambridge, and of a great marine biological laboratory at Penikese. Both were creators, each in his own way. From 1795 to 1873 these two savants "de très grande envergure" gave to natural history the most important impulse which it has ever received, divulging facts more numerous and more clearly founded on exact principles than any other naturalists who preceded them. If Cuvier was superior to Agassiz as a classifier, and a creator of several parts of natural history, Agassiz was above Cuvier as a lover of nature, and a popularizer of science. No naturalist has admired every object of natural history with the enthusiasm of Agassiz. He stood in ecstasy before a zoölogical specimen; whether it was living or fossil was of no importance to him. I doubt if any one has ever handled a specimen with such reverence and veneration as Agassiz always did. Cuvier will always occupy a very exalted position in natural history. He is above the rank and file; while Agassiz is only in the first rank of Cuvier's pupils. Agassiz is a brilliant satellite who has moved in the orbit traced by Cuvier; but what an orbit! and what a brilliant light!

APPENDIX.

APPENDIX A.

BIOGRAPHIES OF LOUIS AGASSIZ.

The biographies of Louis Agassiz are numerous. Many are mere sketches, and more are only repetitions without any original facts. Scientific periodicals, and even literary reviews and political newspapers, have published a number of articles on Agassiz. I shall quote only those containing original matter. The biographical sketches in dictionaries and encyclopædias, such as the "Dictionnaire des Contemporains," by Vapereau; Appleton's "Cyclopedia of American Biographies," and others in English, French, and German, are all compilations, more or less well executed, without real value, except to popularize his name.

Several papers and books have been quoted, which contain original and important facts bearing on the life of Agassiz, although they were published for other purposes, and under titles which do not indicate Agassiz's connection with the subject treated.

1. During his Life.

Only three original biographies were published during his life.

1845. — The first appeared at Geneva in 1845–47, in the "Album de la Suisse Romane," Vol. V., p. 1, 4to, with portrait. The title is *Agassiz*. The name of the author is not given, but in the Table of Contents, at the end of the volume, it is entered as "Par F. J. Pictet," the celebrated naturalist of Geneva. As I have mentioned, the manuscript was sent to Agassiz, at Neuchâtel, for correction.

This article did not make its appearance until Agassiz was already in America; and it is doubtful whether Agassiz ever received a

copy of it, or ever saw it in print. It is excellent, and, although short, is the best biographical sketch we have, so far as it goes; that is to say, up to 1845, when Agassiz was on the point of leaving Neuchâtel for America.

By virtue of his own studies of fossil fishes and fossil invertebrates, Pictet was able to make a just estimation of the merit and originality of Agassiz's researches; and his liberty of judgment and high sense of justice enabled him to examine, without prejudice, the *rôles* played in the glacial question by Venetz, de Charpentier, and Agassiz.

1847. — *The Life and Writings of Agassiz*, published in Boston, December, 1847, in the "Massachusetts Quarterly," Vol. I., pp. 96–119. The author, Mr. J. Elliot Cabot, whose name is not, however, attached to the article, wrote it from materials furnished by Agassiz's secretary, M. Desor. It was substantially a translation, or rather, a report of verbal information; and it may be considered an accurate sketch of Agassiz's life until his acceptance of the professorship of zoölogy and geology at Harvard University. The article was reprinted in the "Edinburgh New Philosophical Journal," Vol. XLVI., p. 1. Edinburgh, 1848.

1847. — At about the same time, 10 December, 1847, a *Biographic Notice of Professor Agassiz* appeared in New York, in a pamphlet entitled, "Professor Agassiz's Lectures: The Animal Kingdom," issued by Horace Greeley, the editor of the New York "Tribune." The proofs of this short sketch, of only two pages, were corrected by Agassiz and Auguste Mayor.

Many newspapers and magazines reprinted in part these last two biographical sketches.

2. After his Death.

1874. — *Commemorative Notice of Louis Agassiz*, by Theodore Lyman. This paper, by one of his favourite pupils, was published as an academic eulogy, in the "Annual Report of the Council of the American Academy of Arts and Sciences for 1873," Boston, 13 pages. It is a good sketch, and very complete, considering its limitation to a dozen octavo pages.

1874. — *Obituary, Louis John Rudolph Agassiz*, by Benjamin Silliman, Jr. In "American Journal of Science," Third Series, Vol. VII., pp. 77–80, January, 1874. The author gives extracts from two letters of Agassiz, dated October, 1845, and February, 1846, addressed to Benjamin Silliman, Sr.

1874. — *Notice biographique sur Louis Agassiz*, par Alphonse de Candolle, dans son Rapport comme Président de la Société de Physique et d'Histoire naturelle de Genève pour l'année 1873–1874. Lu le 16 Juillet, 1874. "Mém. Soc. Phys. et Hist. Nat.," Vol. XXIII., pp. 470–478. 4to, Genève, 1874. An excellent and original biography, containing two most interesting letters addressed to M. Louis de Coulon of Neuchâtel, written by Agassiz, from Paris, during the months of March and June, 1832.

1874. — *Louis Jean Rodolphe Agassiz*, by the Duke of Argyll, in the Anniversary Address of the President of the Geological Society of London, "The Quarterly Journal," Vol. XXX., May, 1874, pp. xxxvii–xliii. This academic eulogy is less complete than that by Mr. Lyman.

1874. — *Louis Agassiz*, by Dr. F. Steindachner, in "Die Feierliche, Sitzung der Kaiserlichen Akademie der Wissenschaften am 30 Mai, 1874. Wien, pp. 60–82. The author, who accompanied Agassiz in his last journey around South America, and passed three years in constant and most intimate intercourse with him, has here written an excellent "Nekrolog," by far the best published in German. Steindachner, being an excellent ichthyologist, was able to appreciate at its full value the great and, as he says, the unique knowledge of Agassiz, whom he justly calls his master.

1874. — (Sketch of) *Professor Louis Agassiz*, by Richard Bliss, Jr., in "Popular Science Monthly," Vol. IV., pp. 608–618, with portrait. New York, March, 1874.

1875. — *Sketch of Agassiz*, by L. F. de Pourtalès, in "Harvard Book," by F. O. Waille and H. A. Clark, Vol. I., pp. 342–344, folio, with an excellent portrait, taken from the larger photograph by Sonrel, Cambridge, 1875.

This sketch contains exact and little known information in regard

to the storage of the first collections made by Agassiz in America, though the account of his European life is short and somewhat inaccurate; *e.g.* Agassiz was never at school at Orbe.

1877. — *Louis Agassiz, notice biographique*, par Ernest Favre, in "Archives des Sciences de la Bibliothèque Universelle," May and June, 1877, 53 pages; issued also separately, Genève. An English translation, made by order of Professor Joseph Henry, the secretary of the Smithsonian, was published in the "Annual Report of the Smithsonian Institution for 1878," pp. 236-261, Washington.

The author was too young to have known Agassiz personally, but he makes good use of the knowledge of his father, Alphonse Favre, an old pupil of Agassiz; and the biography is original and good, containing extracts from letters of Agassiz to Alphonse Favre, and several anecdotes about Agassiz, when in Switzerland. I may add that M. Ernest Favre asked me to write the biography for the "Bibliothèque Universelle." But at the time, I was passing a winter at Algiers, far from all my notes and books; and I declined, but promised to furnish him some notes, more especially upon the life and works of Agassiz in America. He begged me to do so, as otherwise he would not undertake the work. I therefore sent him notes, which he acknowledged very courteously in a foot-note on the first page of his *Notice*. But, influenced by his acquaintance with M. Desor, and also by a little difficulty which had occurred between Agassiz and his father, he gave Desor much more credit for the fossil echinoderms than he is really entitled to, curiously reversing the facts, by saying that Agassiz was the collaborator of his assistant and secretary. Agassiz began the work on echinoderms many years before he knew Desor, and before Desor came to Neuchâtel, as his secretary, and worked out the greater part of it until 1846; and the part taken by Desor is wholly secondary, and far below Agassiz's in excellence. I am obliged to make this statement because M. E. Favre, in quoting me as furnishing numerous facts, seems to indicate that his opinion of the part taken by Desor, in the publication of the "Catalogue des Echinodermes vivants et fossiles," 1846-1848, is more or less in accordance with my information, which is erroneous. As I have previously said, I saw the

manuscript of the Catalogue, from the beginning, at Paris, in 1846; and it fell to my lot to finish it, after M. Desor left Paris, in February, 1847, the memoir appearing in January, 1848, under my editorship.

1879. — *Scientific Worthies. — Jean Louis Rodolphe Agassiz*, in "Nature," Vol. XIX., pp. 573–576. London, April, 1879. This anonymous paper is mainly a translation of Dr. Steindachner's necrology of Agassiz, mentioned above. In the main it is exact, only it is marred by an unusual number of typographical errors, and several dates are not given with sufficient accuracy.

1879. — *Louis Agassiz*, par Louis Favre, in the "Académie de Neuchâtel. Programme des cours pour l'année scolaire 1879–1880." Neuchâtel, 32 pages, 4to, with an excellent portrait. This is by far the best academic eulogy of Agassiz. The author knew Agassiz personally, and, although not a naturalist, had lived long enough among naturalists to be able to appreciate justly the great scientific worth of Agassiz's numerous discoveries. It contains three letters addressed to M. Louis de Coulon, and several extracts from notes dictated by Agassiz. After Mrs. E. C. Agassiz's life of her husband, it is the most important contribution we possess on the life of the great naturalist. It is to be regretted that it is very little known in America and England.

1883. — *Memoir of Louis Agassiz*, 1807–1873, by Arnold Guyot. Read before the National Academy of Sciences, October, 1877, and April, 1878, in Washington. 49 pages, 8vo. Printed at Princeton, New Jersey, and not distributed until April, 1883.

The part relating to Agassiz's stay in the Braun family at Carlsruhe, in 1826, during a vacation, when a student at Heidelberg, is well written and charming; but the author gives too prominent a place to the Glacial question, considering the other researches of Agassiz.

The great objection to Guyot's paper is that it seems to be written not so much in honour of Agassiz, as to urge his own claim to pretended discoveries of the laminated or ribbon structure of the ice. To all impartial glacialists, the part taken by Guyot in the Glacial

question seems extremely slight, and does not compare, either with that played by Venetz, de Charpentier, and Agassiz, or even with that of Rendu, Hugi, Desor, Vogt, Charles Martins, Daniel Dollfus-Ausset, and James D. Forbes. Guyot not only waited many years after the death of Agassiz before publishing his claim, but did not print and distribute his biography of Agassiz until six years after reading it before the National Academy, and one year after Desor's death, and after the disappearance of Forbes, his adversary in the question.

1885. — *Louis Agassiz, his Life and Correspondence*, edited by Elizabeth Cary Agassiz. Boston and London, 2 vols., 12mo, 1885. Two Swiss critics well acquainted with Agassiz and his family have given the key to a just appreciation of the work. M. Auguste Glardon, in the "Bibliothèque universelle et Revue Suisse," June, p. 449, says: "The biography of a celebrated man, more especially when it is due to his widow, always occasions some suspicions. To demand from conjugal love a true impartiality would be entirely unreasonable, and we must expect that a monument erected under such circumstances will always be more or less a mausoleum." The other critic, M. Charles Berthoud, in the "Journal de Genève," 14th December, 1886, after expressing his surprise at the complete silence about the controversy with Karl Schimper, says: "The book is a eulogy, a brilliant picture, without shadows, of a brilliant life, — more than a true portrait. We must wait for a complete biography of the savant." Even as a family eulogy, the work lacks now and then proper appreciation of some of the great difficulties under which Agassiz laboured during the greater part of his life, and of the extraordinary, but always successful, efforts which he made at several critical moments to overcome them, and to continue his herculean labours. There are many parts and some most important acts of Agassiz's life which are not touched, or even hinted at, by Mrs. Agassiz. The obviously eulogistic purpose of the work, and its unquestionably partial character, diminish its interest. With these exceptions, the work of Mrs. Agassiz is most important. It is all that could reasonably be expected from a wife.

1886. — The daughter of Alexander Braun, Mrs. C. Mettenius,

has published a German translation of Mrs. E. C. Agassiz's work, under the title, "*Louis Agassiz, autoriste deutsche Ausgabe von C. Mettenius.* 1 vol., 8vo. Berlin, 1886.

1887. — *Madame Elizabeth C. Agassiz — Louis Agassiz : sa vie, sa correspondance, traduit de l'anglais par Auguste Mayor.* 1 vol., 8vo, 617 pages, with a remarkably good portrait of Agassiz. Neuchâtel, 1887. With the consent of Mrs. Agassiz, M. Mayor has added several notes and extracts from letters not given in the English version, and he has placed at the end the catalogue of Louis Agassiz's publications. With M. Mayor, as well as with Mrs. Agassiz, it was a work of love; and the French version is a marked improvement on the original English edition, being more complete, and, in consequence more valuable, notwithstanding the suppression of a few letters found in the English edition, and the omission of all the engravings, and the substitution of a portrait of Agassiz, which, by the way, is far superior to the one published by Mrs. Agassiz.

1892. — *Louis Agassiz*, par Philippe Godet, in "Petite Bibliothèque Helvétique"; a popular and patriotic publication, containing the biographies of celebrated Swiss. 16 pages, 12mo. Genève, 1892.

1893. — *Louis Agassiz, his Life and Work*, by Charles Frederic Holder. 1 vol., 12mo, 327 pages. New York, 1893. This is a well illustrated volume, giving a sort of *résumé* of Mrs. Agassiz's work, by a person who did not know Agassiz personally. He has gone so far as to quote what he represents as an extract from Agassiz's reply to an offer made by the Emperor Napoleon of a position in France. The correspondence on the subject is well known, having been repeatedly published in newspapers, both in America and in Europe, while I have given in full, in Chapter XVI., pp. 71–72, Agassiz's answer to the offer of M. Rouland, Secretary of Public Institutions, and there is nothing in it resembling Mr. Holder's quotation, "that his family owed nothing to France but exile and poverty; and that he prized more highly the spontaneous gratitude and gifts of a free people than the patronage of emperors and the formal regard of nobles." It is an apocryphal letter. Agassiz was too courteous and too

much a man of the world to write so rudely, in answer to a very flattering and honourable proposal.

At the end of the volume, Mr. Holder gives a "Bibliography of Louis Agassiz," extremely confused, and too often erroneous, repeating papers, and even volumes, and passing over some of Agassiz's most important contributions. *Per contra*, he attributes to Louis Agassiz a book entitled, "A Journey to Switzerland," with which he had absolutely nothing to do.

3. Books and Papers containing Important Facts or Original Views of the Value of Agassiz's Life.

1852. — *Trial of the action* of Edward Desor, Plff. *versus* Chas. H. Davis, Deft. before the Circuit Court of the United States, for the district of Massachusetts; for breach of contract to write a book on the geological effects of the Tidal Currents of the Ocean. Tried before His Honor Peleg Sprague. Boston, 1852, 67 pages. In the Appendix, at p. 53, are the "Award between Edward Desor and Louis Agassiz," and several important letters of Admiral Davis, relating to Agassiz.

1857. — *The Fiftieth Birthday of Agassiz*, by Henry Wadsworth Longfellow. Poem. Reprinted in "Louis Agassiz, his Life and Correspondence," edited by E. C. Agassiz, Vol. II., pp. 544–545; and also in the present work.

1863. — *A Claim for Scientific Property*, by Henry James Clark. 3 pages. Cambridge, July, 1863. Distributed widely among savants and libraries. It is a one-sided view of claims in regard to certain portions of the "Contributions to the Natural History of the United States," by Louis Agassiz.

1868. — *Farewell to Agassiz*. Poem by O. W. Holmes, in the "Atlantic Monthly," Vol. XVI., pp. 584–585. Boston, November, 1865. Written on the occasion of his departure for a journey in Brazil.

1873. — *Addresses and Proceedings at the Agassiz Memorial Meeting at San Francisco*, in "Proceedings California Academy of Sciences," Vol. V., pp. 220–243, December, 1873. Reprinted in

"Louis Agassiz, his Life and Work," by C. F. Holder, pp. 219–267. New York, 1893.

1874. — *Tributes to Professor Louis Agassiz*, in "Proc. Boston Soc. Nat. Hist.," Vol. XVI., pp. 210–237. Boston, January, 1874.

1874. — *The Prayer of Agassiz.* Poem by John G. Whittier, in "Tribune Popular Science," p. 46. Boston, 1874. Reprinted in "The Complete Poetical Works" of Whittier, pp. 383–384. Boston, 1881. Written on the occasion of the opening of the Anderson School of Natural History, at Penikese Island, in July, 1873, when Agassiz called upon his pupils to join in silent prayer, asking God's blessing on their work. Reprinted in the present work.

1874. — *Agassiz at Penikese.* With a portrait. An anonymous article, well written and important, in "Tribune Popular Science," pp. 47–64. Boston, 1874.

1874. — *In the Laboratory with Agassiz*, by a former pupil (Samuel H. Scudder), in "Every Saturday," Vol. XVI., pp. 369–370. Boston, April, 1874. Reprinted in "American Poems," Cambridge, and issued separately, as a leaflet, for the Agassiz Fund, by Mr. Barnard.

1874. — *Recollections of Louis Agassiz, a Chapter of Reminiscences*, by Theodore Lyman, in "Atlantic Monthly," Vol. XXXIII., pp. 586–596. Boston, May, 1874.

1874. — *Elegy of Agassiz*, by James Russell Lowell, in the "Atlantic Monthly," pp. 586–587, published in the chapter of reminiscences, with the preceding paper by Theodore Lyman. Boston, May, 1874. "A long poem," written at Florence (Italy), in February, 1874, which, according to Lowell, "is among his best verses." A very friendly tribute by one who "understood and liked Agassiz better as he grew older." (Letters of Lowell to C. E. Norton, in "Letters of James Russell Lowell," edited by Charles Eliot Norton. Vol. II., p. 114. New York, 1894.)

1875. — *Un naturaliste du dix-neuvième siècle — Louis Agassiz*, par Émile Blanchard, in "Revue des Deux mondes," July and August, 1875, 64 pages. Paris. Issued also separately as a pamphlet.

This is a scientific sketch rather than a biographic notice. The author, an entomologist and a writer of scientific articles in the "Revue des Deux mondes," although slightly acquainted with Agassiz, knew little of his life and of his great works on zoölogy, palæontology, and the glaciers. The article is sympathetic, and written for a special class of readers, not savants, but *dilettanti*; but there is nothing new or impressive in it. M. Blanchard takes this occasion to claim *priority* over Agassiz in regard to the differences presented between species on account of a more or less advanced state of development and the diminution of typical characters among small species of great natural families.

1878. — *Jean de Charpentier*, par le Docteur Herman Lebert, a biography published in "Actes de la Société Helvétique des Sciences naturelles réunies à Bex," août, 1877, pp. 140–154. Lausanne, 1878. In it, two pages, pp. 149–150, are devoted to Louis Agassiz; remarkably correct and of a fine touch; an excellent sketch, by one who had known Agassiz intimately, and was the first savant who associated with de Charpentier in the glacial theory. His reminiscence of Agassiz, with its interesting anecdotes, is most important, and one of the finest tributes to both de Charpentier and Agassiz.

1879–1887. — *Recollections of Agassiz*, by Edwin P. Whipple, in his "Character and Characteristic Men," and "Recollections of Eminent Men," pp. 266–292, and pp. 77–118. 8vo; Boston. 1879 and 1887. An excellent critique, the best from a literary point of view.

1881. — *Louis Agassiz, son activité à Neuchâtel comme naturaliste et comme professeur de* 1832 *à* 1846, par Louis Favre. "Bulletin Soc. Sc. nat. de Neuchâtel," Vol. XII., pp. 355–372. Neuchâtel, 2 Juin, 1881. "Un hommage tardif," as it is called by its author. At the time of Agassiz's death, the president, M. Louis de Coulon, announced the painful news, at the meeting of the 18th December, 1873, simply saying, "M. Agassiz jouissait au milieu de nous de l'estime générale." That was all. And the society founded by Agassiz, in 1832, waited eight years before a eulogy of him was read before it, a "devoir sacré," as it was called by Louis

Favre. The article is good and highly complimentary, but rather "tardif."

1882. — *Eduard Desor. Lebensbild eines Naturforschers*, von Carl Vogt. Breslau. 37 pages. 8vo. Published first in a review, it was afterwards issued as part of the "Deutsche Bücherei." Several pages of this biography of Eduard Desor are filled with notes on Agassiz. Although rather prejudiced, and written in a tone of severe criticism, and entirely hostile to the inhabitants of Neuchâtel, the article contains interesting and generally fair accounts of the life of Agassiz at Neuchâtel from 1839 to 1844, and on the glacier of the Aar from 1840 to 1843. This was during the most active part of Agassiz's scientific life, and at a very critical period in the publication of his costly works. Vogt, with his sharp eyes, inclined to see the humorous of everything, gives a rather piquant inside view of Agassiz's scientific and business methods. The article is written somewhat coarsely, but humorous, and not always in sympathy with his subject; for even his old companion Desor is not secure from his scorching criticism.

1882. — *Alexander Braun's Leben nach seinem handschriftlichen Nachlasz*, dargestellt von C. Mettenius. Berlin, 1882. This most interesting biography of Agassiz's friend and brother-in-law, Alexander Braun, contains several letters by or to Agassiz, and many references to their relations when students at Heidelberg, Munich, and Paris. Although written by his daughter, Alexander Braun's life is not a family eulogy, but a true life, with many private incidents, which give a tone of veracity, most appreciated by those who want to know in full the different phases of the character of a savant.

1882. — *Histoire abrégée de la Société Neuchâteloise des Sciences Naturelles depuis sa Fondation*, par Louis Favre. "Bull. Soc. Sc. Nat. de Neuchâtel," Vol. XIII., pp. 3–33. Neuchâtel, Décembre, 1882. This is an address on the fiftieth anniversary of the foundation of the Natural History Society of Neuchâtel, — "société dont l'idée et l'initiative sont dues à Agassiz," according to the author. It contains important facts in the scientific life of Agassiz during his

stay at Neuchâtel. It was reprinted under the title, "Cinquantenaire de la Société Neuchâteloise des Sciences naturelles," in "Musée Neuchâtelois," Vol. XX., pp. 84–90, and pp. 99–112. 4to. February and March. Neuchâtel, 1883.

1883. — *Louis Agassiz at Neuchâtel*, by Jules Marcou. "The Nation," Vol. XXXVI., pp. 36, 4to. Jan. 11, New York, 1883. We have in this an exact and most complete list of countries where ancient glaciers have been found; proving the existence of a "Glacial epoch," as prophesied by Agassiz at Neuchâtel, in July, 1837.

1886. — *Louis Agassiz. Étude biographique*, par Auguste Glardon, in "Bibliothèque universelle et Revue Suisse." Third series, Vol. XXX., June and July, 1886, pp. 449–481, and 116–146. Lausanne, 1886.

The author, a Vaudois, has known the Agassiz family for the last three generations, and his critical review gives a good and true account of Louis Agassiz. I will quote his own impression of Agassiz's departure from Neuchâtel for America: "Il était deux heures du matin, lorsque le professeur quitta la maison qui avait pendant treize ans abrité son bonheur domestique et ses collections. Les étudiants vinrent en corps lui donner une sérénade d'adieu à la lueur des flambeaux; ses collègues de l'Académie étaient aussi présents. L'émotion était générale; plusieurs avaient le pressentiment que l'Amérique retiendrait le professeur aimé et qu'on ne le reverrait jamais."

1886. — *Glaciers and Glacialists*, by Jules Marcou. "Science," Vol. VIII., pp. 76–80, 4to. July 23, New York, 1886. This is an explanation of the glacial doctrine, with dates of the discoveries, and an account of the part taken by Louis Agassiz.

1886. — Of all the numerous articles in newspapers, American or foreign, reviewing the work of Mrs. Agassiz in the English, German, and French versions, I shall quote only one containing original suggestions and facts not recorded in the work. It is a review in the "Journal de Genève" of the 14th December, 1886, entitled: *Louis Agassiz, sa vie et sa correspondance*, by Charles Berthoud, an

old friend of Agassiz, who freely speaks his impressions of the book and its contents in the words, "Ce livre n'est point une biographie scientifique," and he regrets to find so few letters of Agassiz on scientific subjects.

1887. — *Das 50 jährige Jubiläum der Eiszeit-Lehre*, 1837, 15 Feb. 1887, von Dr. Otto Volger, in "Beilage zur Allgemeinen Zeitung." München, pp. 697, 698, and pp. 715, 716. Folio, Munich, 1887. The facts, although quite correct in the main, give only the views on one side, in favour of Karl Schimper's claim; and the article is unjust in regard to Agassiz's part in the controversy.

1887. — *Il Naturalista Agassiz secondo le memorie scritte da sua Moglie*, by Paolo Lioy, in "Nuova Antologia." Terza serie, Vol. VIII., pp. 240–258. Roma, Italy, 16 Mazo, 1887. A remarkable and fascinating article, full of life, and written with such a *brio* that Agassiz seems to pass before the eyes.

1887. — *Souvenir de l'inauguration du buste élevé à L. Agassiz par la Société des Belles-Lettres dans le Bâtiment Académique de Neuchâtel, le 12 Mai*, 1887. 65 pages, 8vo, with portrait. Neuchâtel, 1887. Several of the speeches and addresses delivered during the ceremony contain new facts and special characteristics, as well as anecdotes in regard to the great naturalist.

1889. — *La première Académie de Neuchâtel. Souvenirs de* 1838–1848, par Alphonse Petitpierre. 12mo. Neuchâtel, 1889. This contains several extremely interesting letters of Agassiz. The author shows the great part taken by Agassiz in the founding of the Academy, and its prosperity so long as he inhabited Neuchâtel.

1892. — *Agassiz at Penikese*, by David S. Jordan, in "Popular Science Monthly," Vol. XL., pp. 721–729. New York, April, 1892. An interesting reminiscence of the school at Penikese Island in 1873, by one of the pupils.

Post-scriptum. — Finally, Jean Jacques Antoine Ampère in his book, *Promenades en Amérique* (2 vols., 1852), speaks of his stay at Agassiz's house in Cambridge; and Auguste Laugel, some years after (1865), in a volume on *Les États-Unis pendant la guerre de*

Sécession, gives an account of a visit to Agassiz. The last author has also published in the "Revue de Deux mondes," of 1857, an article entitled: *M. Agassiz et ses travaux*. Vol. XL., pp. 77–108. The celebrated Julius Froebel, of kindergarten fame, in his work *Aus Amerika*, 1857, relates a visit to Agassiz.

Second *Post-scriptum*. — 1863. — *Étude sur l'industrie huitrière des États-Unis*, par Philippe de Broca, contains a letter of Agassiz and notes on the acclimatization of oysters, pp. 4–6. Extrait de la "Revue Maritime et Coloniale," Paris, 1863.

1869. — *De la Science en France*, par Jules Marcou, contains an interesting letter of Agassiz, and a list of Agassiz's principal publications, pp. 185–191, Paris, 1869.

APPENDIX B.

AGASSIZ'S PORTRAITS, ENGRAVINGS, PHOTOGRAPHS, BUSTS, MEDALS, AND TABLETS.

Agassiz's face has been popularized by many portraits, although not a single good oil portrait of him exists. The only good coloured picture is a miniature pastel drawing, made by his first wife, when he was a student at Heidelberg, at the age of nineteen. A copy of it forms the frontispiece of Vol. I., of "Louis Agassiz, his Life and Correspondence," edited by Elizabeth Cary Agassiz.

In 1840, Jacques Burkhardt made a portrait of Agassiz, but it is a very poor likeness. It is preserved in the public library of Neuchâtel.

In 1842, Agassiz's portrait was painted, of natural size, by an artist of the name of Zuberbühler. His face is much coloured, as if by sunburn, and he is dressed in a brown coat, decorated with a long golden chain, and is represented surrounded by masses of ice. It is a poor likeness, and the picture as a whole is not in good taste. The original is now at the house of Mr. Alexander Agassiz at Cambridge. A copy of it, made at Neuchâtel for M. Auguste Mayor, has been improved in regard to the surroundings; instead of a great mass of ice with blue-green crevices, the background is occupied by a true landscape of the glacier of the Aar, and showing the Finsteraarhorn, the Agassiz's horn, and the "Hôtel des Neuchâtelois."

In 1846, M. Fritz Berthoud, a banker of Neuchâtel, at the same time an amateur painter, then a resident of Paris, made a full-length

picture of Agassiz and Desor on the same canvas; neither is a good likeness, that of Agassiz more especially being very poor. This large picture is now in the fine picture gallery of the city of Neuchâtel.

In 1886, another oil portrait, by Alfred Berthoud, by order of the Canton of Neuchâtel, was painted, and placed, first, in the hall of the Great Council of the canton, and afterward in the *Aula* of the Academy of Neuchâtel.

After Agassiz's death, in 1875, a large oil portrait was made by Mrs. C. V. Hamilton, and is placed in the library of the Boston Society of Natural History. The likeness is not good, and it is a very poor representation of the great naturalist. A painter named Billings, also, made an unsuccessful attempt at a picture of Agassiz.

Lately, 1894, another three-quarters length life-sized portrait of Agassiz has been executed in oil, by an American artist, Walter Gilman Page, who never saw him when he was alive. The flesh tints are far too exaggerated, and the picture does not give a correct idea of the original. It also is an unsatisfactory likeness. It has been placed at the Agassiz School in Jamaica Plain, near Boston.

If we do not possess a single good likeness in oil of Agassiz, we have, *per contra*, many excellent lithographs and photographs. The first one is to be found in "Excursions et séjours dans les glaciers et les hautes régions des Alpes, de M. Agassiz et de ses compagnons de voyage," par E. Desor, Neuchâtel, 1844. It is the frontispiece of the volume, and was drawn on stone, by A. Sonrel, from a daguerrotype of very small size. The likeness was not very good, except the upper part of the head.

The second was published in the "Album de la Suisse Romane," Geneva, to accompany his biography, page 1, by his friend Jules Pictet de la Rive, in Vol. V., 1847. The drawing was made on stone, from life, by M. P. Élie Bovet, at Neuchâtel, in 1845. It is a good portrait, cabinet size; rather rare. It was unknown to his family, as well as the biography, until I discovered them in 1887, while reading Agassiz's correspondence with Pictet.

The third portrait appeared as the frontispiece of the first volume of "The Annual of Scientific Discovery; or, Year-Book of Facts in Science and Arts," edited by David A. Wells and George Bliss,

1849, Boston. It was drawn on stone, by A. Sonrel, from a daguerrotype. The likeness is not satisfactory. This is the first time that a facsimile of his signature was published under the portrait.

After 1859, many photographs were taken, more especially by A. Sonrel. All are good likenesses. I shall mention only the larger ones. A large sized one was taken in 1863, and has circulated much among his friends and students. A reduction of it is engraved as a frontispiece of Agassiz's "Geological Sketches," Boston, 1870.

Another full-length photograph was taken in 1869, representing Agassiz, Professor Benjamin Pierce, then Superintendent of the United States Coast Survey, and Captain Carlisle P. Patterson, Chief Hydrographer of the Coast Survey; all three are seated.

The same year, 1869, another large photograph represented Agassiz seated and looking at a globe, on which Professor Pierce, who is standing, points out the Gulf Stream above the Pourtalès Plateau. Both portraits are excellent. The one of Agassiz, representing him almost in profile, has been reproduced since by Justin Winsor in his Vol. I., p. 373, of his "Narrative and Critical History of America."

A cabinet photograph was taken at San Francisco by Watkin, in 1872, just after his arrival from his voyage in the *Hassler*. A good photograph of Mrs. Agassiz was made at the same time.

Another cabinet photograph, in 1872, the last made by Sonrel, is a splendid profile of Agassiz; it was taken especially for the engraving of the large bronze medal at Neuchâtel, by Professor F. Landry. I give it as the frontispiece of Vol. I.

Among the numerous *cartes de visite*, I may mention one taken in 1863, representing Agassiz seated, with manuscript in his left hand; it is remarkably well executed, showing his peculiar attractive smile and brilliant eyes. Another taken at the same time, represents him in front of the blackboard and lecturing before his pupils, with an echinide drawn in white chalk on the blackboard. Eight years later another photograph represented Agassiz and Pourtalès together seated at a table, on which lie a book, a stone, and specimens of echinoderms; Agassiz holds an echinus in his left hand, and in the right hand a lens, through which he is

looking attentively at the specimen. This portrait, with a few changes, has been used by Mr. C. F. Holder, as the frontispiece for his volume, "Louis Agassiz, his Life and Work," New York, 1893; but the engraving is very poor, and the likeness decidedly bad. In 1866, when at Rio de Janeiro, just after his return from the Amazons, Agassiz was taken at full length with his friend Major Coutinho, Agassiz's right hand resting on the right shoulder of Coutinho. This is one of the most animated portraits of Agassiz, who looks browned by his ten months' stay on the great Amazons, but full of life and very spirited, with his piercing eyes and his strong frame, so much in contrast with Coutinho's small size.

The portrait of Agassiz, forming the frontispiece of Vol. II. of Mrs. Agassiz's life of her husband, is taken from an engraving, which appeared in "Nature," April, 1879, with a biography of Agassiz, one of the "Scientific Worthies Series" of that periodical. The likeness is poor. But in the French translation of Mrs. Agassiz's work, by Auguste Mayor, the frontispiece portrait of Agassiz is excellent, the best by far of all those published. The portrait published by Louis Favre, in his biography of Agassiz, forming part of the "Programme des cours de l'Académie de Neuchâtel pour l'année scolaire, 1879, 1880," is also a good likeness.

I know only one double photograph of Agassiz for use in a stereoscope. It was made by Sonrel in 1861, and represents Agassiz in his library at his home in Quincy Street. A part of the library is visible, as well as a geological map of Central Europe hanging against the bookcase. It was made as an imitation of "Alexander von Humboldt in his library," a popular engraving often seen in Germany and Switzerland, and a part of which may be seen in the corner of the photograph. Agassiz is seated at his desk, loaded with manuscripts, and looking through a magnifying-glass at a fossil on a small stone held in his left hand. The expression is rather too serious, but it is a good portrait.

As to the three busts executed after his death, by three artists who had never seen him, they are all poor so far as likeness is concerned. One is by Mr. Preston Power, and may be seen at the Agassiz Museum, and a cast of it at the library of the Boston

Society of Natural History; the second, by Henry Dexter, is in the gallery of the Museum of the Boston Society of Natural History; the third, by M. Iguel of Neuchâtel, was erected with appropriate ceremonies, May 12, 1887, at the Academy of Neuchâtel, by the "Société de Belles-Lettres" of Switzerland, which raised a subscription among its members to cover the expenses. This bust, by M. Iguel, although well executed and more elaborate than the others, does not give a true likeness of Agassiz, not even so good as the one by Power. It is placed on a pillar of brown marble, on which is engraved: "A Agassiz, la Société de Belles-Lettres, 1887."

Medals and Tablets.

The medals executed, one at Neuchâtel and the other at the National Mint in Philadelphia, are both good. The one engraved at Neuchâtel and coined at Geneva in 1876 is very remarkable, both on account of its execution and its size; it is one of the best medals ever struck, being so large as to look like a medallion, and is most creditable to the engraver, Professor Fritz Landry, of Neuchâtel. The module or size is 94 mill. On the obverse, the legend is Ls. Agassiz, 1807–1873, — F. Landry, Neuchâtel, Suisse. On the reverse we read as exergue enclosed in a crown of laurels: *Viro ingenio labore scientia Præstantissimo.* It is a bronze medal, of which one hundred and fifty-one copies were struck, and two copies in silver by special request.

The other, engraved in 1875 by W. Barber, an artist at the Philadelphia Mint, is much smaller. The size is 45 mill., and is the one used by the National Government for all medals struck to honor the memory of great men in America. The medal taken as a model for that series is the Benjamin Franklin medal, engraved by A. Dupré, in 1784, at Paris. The size is rather small, which gives to all these medals an unattractive appearance. The profile of Agassiz is good, but the details are not so harmonious and exact as they were in nature and in the photograph used by the engraver. On the obverse, the legend is simply *Agassiz*, without any of his Christian names. On the reverse, we read as exergue *na.* 1807, *ob.* 1873, and as legend: *Terra Marique Ductor indagatione naturæ.* This medal also is bronze. During 1876 and 1877 only

thirty-one copies were struck; and, in 1879, a silver one was struck, according to the reports of the director of the Mint.

Tablets to the memory of Louis Agassiz have been placed in Europe and in America. The inhabitants of his birthplace placed over the door of the parsonage of Motier (Fribourg) a marble tablet with the inscription: "J. Louis Agassiz, célèbre naturaliste est né dans cette maison, le 28 Mai, 1807"; and the Cornell University at Ithaca, New York, unveiled a marble tablet, in commencement week, June, 1885, in the founder's chapel. At the opening of the University in 1868, Agassiz was present, made a speech, and immediately after began a course of twenty lectures before a very large audience, including almost all the professors, instructors, and students. The inscription on the tablet reads in black lines as follows: "To the Memory of Louis Agassiz, 1807–1873. In the midst of great labors for science throughout the world, he aided in laying the foundation of instruction at the *Cornell University*, and by his teaching here gave an impulse to scientific studies which remains a precious heritage. The Trustees, in gratitude for his counsels and teachings, erect this memorial, 1884."

In September, 1885, a large stone slab was placed by his son in the wall of the entrance hall of the Museum of Comparative Zoölogy at Harvard University, with the following inscription: "Ludovici — Agassiz — Patri — filius — Alexander — MD — CCC — LXXX."

An Agassiz Memorial Fund was subscribed during 1874 and 1875, to be used for the completion of his Museum. $245,792 were received, of which $130,000 came from his son and his daughter Pauline, and $9192 from teachers and pupils, while the state granted $50,000, the total amounting to $310,600.

But the most original memorial is the inscription on the boulder of micaceous schist, once forming part of the "Hôtel des Neuchâtelois," on which is engraved in large letters *L. Agassiz* above the name of *Hôtel des Neuchâtelois*, 1840.

In 1844, the roof and sides of the "Hôtel des Neuchâtelois" broke apart, and afterward frost divided the boulder into a thousand pieces. Happily, Edouard Collomb, in 1842, had drawn, in water colour, the north face of the block on which were engraved the

names of all the assistants. Daniel Dollfus-Ausset has since published the picture in his Atlas of the "Matériaux pour l'étude des glaciers"; and, at my suggestion, a small, but good, reproduction of it was given in "Science," Vol. IV., p. 360, October, 1884, Cambridge. A correct and successfully executed reproduction of Collomb's water colour picture of the "Hôtel des Neuchâtelois" is given in Vol. I., opposite p. 202. In August, 1884, several pieces with inscriptions on them were found at a great distance: twenty-four hundred metres lower than the position of the hotel, as determined by Agassiz in 1842, giving an average annual velocity of fifty-five meters. Thus, many years after his death, Agassiz, through his inscriptions on the boulder, is still the promoter of valuable discoveries on the Aar glacier.

APPENDIX C.

LIST OF LOUIS AGASSIZ'S PAPERS AND WORKS ARRANGED CHRONOLOGICALLY.[1]

1828. — 1. *Cynocephalus Wagleri.* — *Isis*, 1828, Part IX., pp. 861–863, with a Fig. Translated into French and reprinted in *Férussac, Bull.*, Vol. XIX., 1829, pp. 345–346, under the title "Description d'une nouvelle espèce du genre Cynocéphale."

1828. — 2. Beschreibung einer neuen species aus dem genus *Cyprinus*. (*Cyprinus uranoscopus*) nouvelle espèce trouvée par Agassiz à Munich, et présentée à la réunion des savants d'Allemagne à Berlin par Oken. — *Isis*, 1828, Part X., pp. 1046–1049, and *Isis*, 1829, Parts III. and IV., pp. 414–415. French translation in *Férussac, Bull.*, Vol. XIX., 1829, pp. 117–118.

1829. — 3. Selecta genera et species piscium quas in itinere per Brasiliam annis 1817–1820 collegit et pingendos curavit J. B. de Spix; digessis, descripsit et observationibus anatomicis illustravit Dr. L. Agassiz; præfatus est et edidit itineris socius Dr. de Martius. Monachii, 1829, folio with 29 plates. Reviewed in *Isis*, 1829, Part VII., p. 715.

1830. — 4. Dissertatio inauguralis: De taxi et syntaxi morphomatum telæ corneæ dictæ. 4to, Monachii, 1830. This title is in the centre of the second page. On the first page used as a cover

[1] Several short papers appear more than once in this list, because they are either extracts from some of the larger works of Agassiz, or because he was in the habit of sending the same paper, with only a few words changed, to several scientific periodicals. This is unavoidable in a complete Bibliography.

we read: Ad Disputationem publicam [under the presidency of Roeschlaub]. Pro summis in medicina chirurgia et arte obstetricia honoribus rite obtinendis a prænobili, clarissimo et doctissimo viro ac domino Ludovico Agassiz, A. A. LL. Philos. Doct. Urbigenensi, Helveto, Die III, Aprilis, MDCCCXXX. habendam, etc.

There are 74 theses. Thesis 1, page 3, entitled: Fœmina humana superior mare, caused a sensation among the examiners and the audience, for Agassiz proved that the organization of woman was more complicated and superior to that of man.

1830. — 5. Prospectus de l'"Histoire naturelle des Poissons d'eau douce de l'Europe centrale, ou Description anatomique et historique des Poissons qui habitent les lacs et les fleuves de la chaine des Alpes et les rivières qu'ils reçoivent dans leurs cours." Small folio, Munich, 1830. This rare prospectus preceded by twelve years the publication of the first part of the work, which will be found in its chronological place, No. 90, 1842. An announcement of the proposed work is inserted in *Férussac, Bull.*, Vol. XXIII., p. 271. 1830.

1832. — 6. Untersuchungen über die fossilen Süsswasser-Fische der tertiären Formation. *Leonhard und Bronn, Jahrb.*, pp. 129–138. 1832.

1832. — 7. Untersuchungen über die fossilen Fische der Lias formation. *Leonhard und Bronn, Jahrb.*, pp. 139–149. 1832.

1833. — 8. Tableau synoptique des principales familles des plantes. 12mo. Neuchâtel, 1833.

1833–1844. — 9. Recherches sur les Poissons fossiles, 5 Vols. 4to. with four hundred coloured folio plates. Neuchâtel, 1833–1844.

The work was noticed in *Isis*, 1834, Part IV., p. 405, and 1835, Part II., p. 135; in *Leonhard und Bronn, Jahrb.*, 1834, pp. 242, 484; 1835, p. 595, etc.; 1844, p. 250. Also in *Silliman's Amer. Journ. Sc.*, Vol. XXVIII., p. 193, and Vol. XXX., p. 34.

1833–1835. — 10. Résumé des travaux de la section d'histoire naturelle, et de celle des sciences médicales (de la Société des sciences naturelles de Neuchâtel) pendant l'année 1833. *Mém. Soc. sc. nat. Neuchâtel*, Vol. I., pp. 17–28, Neuchâtel, 1835. Although the

volume was not distributed until 1835, the report was issued among the resident fellows at the end of 1833.

1833. — 11. Neue Entdeckungen über fossile Fisches. *Leonhard und Bronn, Jahrb.*, pp. 675–676. 1833. Also in *Edinb. New Phil. Journ.*, Vol. XXXVII., p. 331.

1833. — 12. Synoptische Uebersicht der fossilen Ganoiden. *Leonhard und Bronn, Neues Jahrb.*, 1833, p. 470.

1834. — 13. Remarks on the different species of the genus *Salmo* which frequent the various rivers and lakes of Europe. *Report, British Assoc. Adv. Sc. Edinburgh*, pp. 617–623. 1834. *Edinb. New Phil. Journ.*, Vol. XVII., pp. 380–385. 1834. *L'Institut*, Vol. III., pp. 72-73. Paris.

1834. — 14. On the fossil fishes of Scotland. *Report British Assoc. Adv. Sc. Edinburgh*, pp. 646–649. Reprinted in *L'Institut*, Vol. III., No. 94. pp. 65–66. Paris, 1835.

1834. — 15. On a new classification of fishes, and on the geological distribution of fossil fishes. *Proc. Geol. Soc. London*, Vol. II., No. 37, pp. 99–102. November 5, 1834. Also in *London and Edinb. Phil. Mag.*, Vol. V., pp. 459–461. London, 1834. And in *Edinb. New Phil. Journ.*, Vol. XVIII., pp. 175–176. 1835.

1834. — 16. On the anatomy of the genus *Lepidosteus*. *Proc. Zoöl. Soc. London*, Vol. IV., pp. 119–120. 1834. Also in *L'Institut*, Vol. III., p. 190. Paris, 1835.

1834. — 17. Observations on the growth and the bilateral symmetry of the Echinodermata. *London and Edinb. Phil. Mag.*, New Series, Vol. X., pp. 369–373. London, 1834. Reprinted under the title: Ueber die äussere Organisation der Echinodermen in Oken, *Isis*, pp. 254–257. 1834.

1834. — 18. Ueber das Alter der Glarner Schiefer-Formation nach ihren Fischresten. *Leonhard und Bronn, Neues Jahrb.*, 1834, pp. 301–306.

1834. — 19. Allgemeine Bemerkungen über fossile Fische. *Leonhard und Bronn, Neues Jahrb.*, 1834, pp. 379–390.

1834. — 20. Résumé des travaux de la section d'histoire natu-

relle, et de celle des sciences médicales de la Société des sciences naturelles de Neuchâtel, pendant l'année 1834. *Mém. Soc. sc. nat. Neuchâtel*, Vol. I., pp. 28–32. 1834.

1834. — 21. Description de quelques espèces de Cyprins du lac de Neuchâtel, qui sont encore inconnues aux naturalistes. *Mém. Soc. sc. nat. Neuchâtel*, Vol. I., pp. 33–48. Neuchâtel, mai, 1834. *L'Institut*, Vol. IV., pp. 419–420. Paris, 1836.

1835. — 22. Notice sur les fossiles du terrain crétacé du Jura Neuchâtelois. *Mém. Soc. sc. nat. Neuchâtel*, Vol. I., pp. 126–145. 1835. *L'Institut*, Vol. IV., pp. 420–421. Paris.

1835. — 23. Prodrome d'une monographie des Radiaires ou Echinodermes. *Mém. Soc. sc. nat. Neuchâtel*, Vol. I., pp. 168–199. 1835. (Read the 10 January, 1834.) *Ann. sc. nat. Zoologie*, pp. 257–296. Paris. *Ann. nat. Hist.* or *Mag. Zoöl. Bot. & Geol.*, Vol. I., pp. 30–43, 297–307, 440–449. London, 1838.

1835 — 24. Sur les Belemnites (mémoire communiqué à l'académie des Sciences par Férussac). *Comptes Rendus Acad. sc. Institut de France*, Vol. I., p. 341. Paris. Reprinted under the title, "Ueber Belemniten." *Leonhard und Bronn, Neues Jahrb.*, 1835, p. 168.

1835. — 25. Revue critique des Poissons fossiles figurés dans l'*Ittiolithologia Veronese*, Neuchâtel, 1835. *Leonhard und Bronn, Neues Jahrb.*, 1835, pp. 290–316.

1835. — 26. Sur les poissons fossiles de la formation houillère. *L'Institut*, Vol. III., pp. 253–254. Paris, 1835.

1835. — 27. On the principles of classification in the animal kingdom in general, and among mammalia in particular. *Report British Assoc. Adv. Sc., Dublin*, pp. 67–68. 1835.

1835. — 28. Systematic enumeration of the fossil fishes in English collections. *Proc. Geol. Soc. London*, Vol. II., pp. 207–208. Nov. 7, 1835. Translated into French, under the title, "Sur les Poissons fossiles de l'Angleterre," *L'Institut*, Vol. IV., pp. 85–86. Paris, 1836.

1835. — 29. Remarques sur les Poissons fossiles. *Bull. Soc. natur. Moscou*, Vol. VIII., pp. 180–201. Moscou, 1835.

1835. — **30.** Coup d'œil synoptique des Ganoïdes fossiles. *Bull. Soc. natur. Moscou*, Vol. VIII., pp. 202–318. Moscou, 1835.

1835. — **31.** Views of the affinities and the distribution of the Cyprinidæ. *Proc. Zoöl. Soc.*, 1835, pp. 149–151. London.

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Nota bene. — Les "Observations sur les progrès, etc.," ont été tirés à part et distribués en juillet, 1841. 20 pages, 4to, avec une page de title: "Monograph d'Échinodermes (Extrait de la seconde livraison de cet ouvrage, etc.)." English translation: "Observations on the progress recently made in the natural history of the echinodermata."

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1842.—90. Histoire naturelle des poissons d'eau douce de l'Europe centrale. 1 vol., 8vo, and folio atlas of 41 coloured plates. Neuchâtel, 1842.

1842. — 91. Monographies d'Échinodermes, vivans et fossiles. 4ième livraison, "L'anatomie du genre echinus," par G. Valentin; avec une "Preface par Agassiz." 4to. Neuchâtel, 1842.

The "preface" of ten pages by Agassiz is important because in it he says that Valentin delivered his manuscript into his hands as far back as 1840, and the "Preface" is dated December, 1841. The exact date of the issue of the fourth part or "livraison" is marked on the cover, — 1842. It is the last part of those monographs of the Echinodermata.

The third monograph, "Des Galérites," and the fourth monograph, "Des Dysaster," forming together the third part, or "3ième livraison," are by E. Desor; and the part was issued in 1842. Like the other parts, it was published "aux frais de L. Agassiz."

1842. — 92. No title. The paper has been quoted under the following designations: 1st, "Lettre sur la structure lamellaire des glaciers que s'attribue Mr. James D. Forbes." 2d, "A reply to Mr. James D. Forbes on the laminated structure of glaciers." 3d, "Agassiz's controversy with James D. Forbes, of Edinburgh." Neuchâtel, 10 pages. 4to. 11 avril, 1842. Expédié de Neuchâtel, le 21 avril, 1842. In it is reprinted a letter of Professor James D. Forbes to M. Desor, which was largely distributed among savants by Professor Forbes.

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1842. — 94. New Views regarding the distribution of fossils in formations. *Edinb. New Phil. Journ.*, Vol. XXXII., pp. 97–98. Edinburgh, January, 1842.

1842. — 95. Matériaux pour une bibliothèque zoologique et paléontologique. 562 pages, folio. Neuchâtel, 1842.

1842. — 96. Reiseproject nach dem Aargletscher, Hügi über Gletscher; Myaceen. *Leonhard und Bronn, Neues Jahrb.*, pp. 313–317. 1842.

1842. — 97. Vortrag über seine Gletscheruntersuchungen auf

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1843. — **102.** Synoptical table of British fossil fishes, arranged in the order of geological formation. *Report British Assoc. Adv. Sc.* 1843, pp. 194–207. *Edinb. New Phil. Journ.*, Vol. XXXVII., pp. 331–347. *Ann. Sc. Nat. Zoologie*, 3e Série, pp. 251–271. Paris, 1844.

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1843. — **104.** Notice sur la succession des Poissons fossiles dans la série des formations géologiques. (Extrait de la 18e et dernière livraison des *Recherches sur les Poissons fossiles.*) 16 pages, 4to. Neuchâtel, 1843. *Ann. Sc. Nat. Zoologie*, 3e Série, Vol. II., pp. 251–271. Paris, 1844.

1843. — **105.** Sur les glaciers. *Actes Soc. Helvétique sc. nat. Lausanne*, 24, 25, *et* 26 *juillet*, 1843, pp. 72–74. Lausanne, 1843.

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